PUBLIC WORKS

City, County and State

Barrett Tarvia

GOOD ROADS AT LOW COST

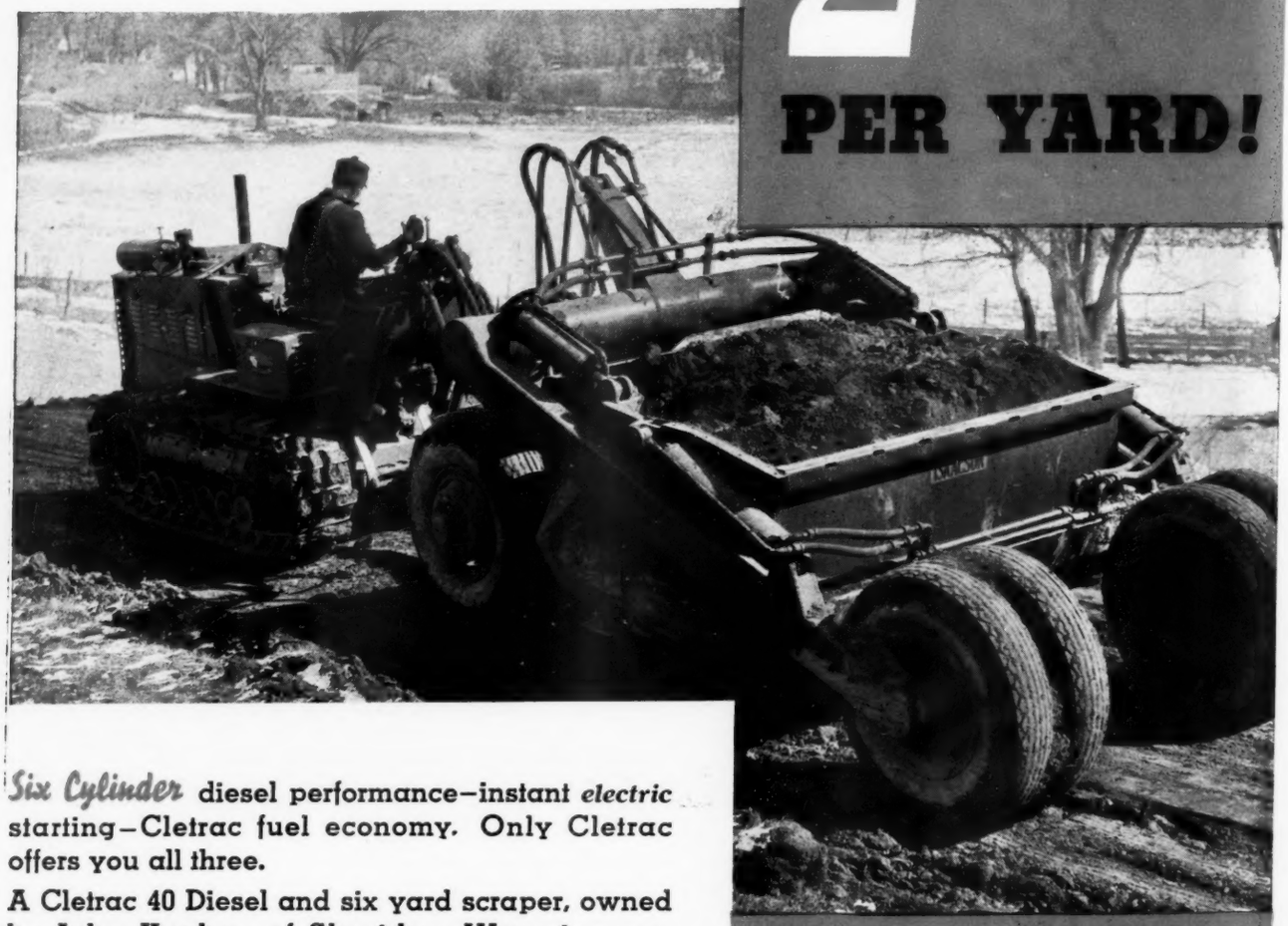
Grafton Road, Massachusetts, on route from Worcester to Providence. Tarvia-built in 1913, before the World War, this Tarvia road remains as smooth, easy-riding and skid-safe as it was the year it was laid.

To road officials and highway engineers traffic-safety of a road is equally as important as its durability and low cost. Tarvia roads qualify on all counts. Tarvia penetrates deeply into the road crust, holding the stone or gravel firmly exposed on the road surface. The resulting slightly granular surface, which is characteristic of Tarvia road types, provides an effectual tread-hold for automobile tires. Let the Tarvia field man help you provide *safe* roads.

THE BARRETT COMPANY New York Chicago Philadelphia Cleveland Birmingham St. Louis Boston Minneapolis
Toledo Milwaukee Detroit Baltimore Columbus Youngstown Lebanon Buffalo Providence Syracuse Hartford Cincinnati
Bethlehem Rochester Portland, Me. In Canada: THE BARRETT COMPANY, LTD. Montreal Toronto Winnipeg Vancouver

MAY, 1935

A FUEL COST OF *less than* 1/2 cent PER YARD!



Six Cylinder diesel performance—instant *electric* starting—Cletrac fuel economy. Only Cletrac offers you all three.

A Cletrac 40 Diesel and six yard scraper, owned by John Keahey of Sheridan, Wyoming, are shown at work on a cut and fill highway grading job. Temperatures were continuously below freezing and the hard, unscarified clay was frozen 6″ to 8″ deep. The 40 Diesel averaged 65 yards per hour on a 350 foot haul. Fuel consumption was 2.6 gallons per hour at a fuel cost of *less than ½ cent per yard*. Cletrac owners everywhere are showing results like these.

THE CLEVELAND TRACTOR COMPANY • Cleveland, Ohio

Investigate Cletrac's economy, dependability and low maintenance costs on *your own* jobs. There is a Cletrac Model designed to meet your tractor requirements.

CLETRAC CRAWLER TRACTORS

VOL. 66 PUBLIC WORKS No. 5

Entered as second-class matter at the Post Office at New York, N. Y., Sept. 1, 1922, under the act of March 3, 1879.
Published Monthly by PUBLIC WORKS JOURNAL CORPORATION, 310 East 45th St., New York, N. Y.
Subscription Rates: United States and Possessions, Mexico and Cuba, $3.00. All other countries, $4.00.

MAY, 1935

May 1935

PUBLIC WORKS

Vol. 66 No. 5

CITY, COUNTY AND STATE ENGINEERING AND CONSTRUCTION

TABLE OF CONTENTS FOR MAY, 1935

Editorial 27

Highways and Streets

Curb and Gutter Built by Relief Labor at Low Cost 14
Paving for Unemployment Relief Paid for by Voluntary Assessments. *By F. H. Conner and L. C. Britton* 17
Ohio's New Method of Road Mix Treatment. *By G. M. Anderson* 44
Flake Calcium Chloride Dissolves in Cement Mixer 46
Building Highway Surfaces for Modern Traffic. *By G. E. Martin* 48
Powdered Asphalt in Oil Mat Construction. *By H. C. Offutt* 50
Diesel Tractors Operate Cheaply on Highway Construction 54

Sewerage and Sanitation

Sewage Progress in the Central States 9
Studies of Sewage Purification. *By C. T. Butterfield* 15
Activated Sludge Plant at Springfield, Mo., With Unusual Features. *By Joe Williamson, Jr.* 19
Sewage and Industrial Waste Treatment at Waconia. *By H. D. Halvorson and Randolph L. Smith* 23
Treating Malt House Wastes 34
The DIGESTION TANK: Chemical treatment—Flexibility of chemical treatment—Sedimentation tank design—Oil and grease removal—Spray drying—Pulp mill wastes—Non-corrosive sewer linings 40
Pensacola's Proposed Sewage Treatment Plants 54

Water, Light and Power

Water Works and Sewerage Progress in the Central States 9
Pressure Zeolite Water Softening at Elmore, O. *By R. F. MacDowell* 10
Lime-Soda Water Softening at Grafton, O. *By R. F. MacDowell* 11
Operating Results at the Burnt Mills Purification Plant. *By Robert B. Morse* 20
Thirteen Miles of Large Steel Mains Laid by St. Louis. *By C. M. Daily* 25
Soil Technology in Earth Dam Construction as Employed in Back Creek Dam. *By C. A. Hogentogler, Jr.* 28
Horton, Kansas, Municipal Light and Power Plant Gives Good Service at Low Cost. *By H. L. Lingo* 31
Constructing Ten-Mile Pipe Line With Relief Labor 33
The WATER WHEEL: Taste and odor—Lime softening—Filter bottoms—Scoring water supplies—Joint use of service trenches—Pipe friction—Frost penetration 36

Departments

New Equipment 54, 56
Readers' Service 63
Engineers' Library 66

TIMEWASTERS

Mikey & Ikey Do Some Speeding:

Mikey and Ikey have been working on a farm during the winter. Last week the farmer sent them into town to sell a load of potatoes. Mikey drove the truck into town, all right, at a speed of 10 miles an hour, which was about all the ancient flivver would stand. Celebrating the bright lights of Main Street, Podunk Center, Mikey and Ikey became somewhat exhilarated, however, and Ikey had to pilot the truck back to the farm. In order to avoid the double row of telegraph poles, Ikey stepped on the gas. By dint of much perspiration, they wheeled the old boat back to the farm at the rate of 15 miles an hour. What was the average rate of speed for the round trip to town and back?

The Ten Words of Sandy MacTavish:

Sandy was away from home on a trip, when something terrible occurred, which made it absolutely necessary that he send a telegram to his wife. Even in this hour of dire disaster, Sandy's natural aversion to waste remained predominant, and he negotiated his message as follows:

BRUISES HURT ERASED AFFORD
ERECTOR ANALYSIS HURT TOO
INFECTIOUS DEAD.

Sandy

The telegram told the whole story. What did it say?

The Superintendents' Special:

A waterworks superintendent bought a batch of water meters last January so that he could keep some of the ERA boys real busy. In February he sold four meters to a neighboring city, and intalled one-sixth of the remainder. In March, in checking over his lists, he found that three meters had been stolen, but his forces, hampered by the cold weather, installed one-sixth of those on hand. His neighbor superintendent borrowed two more in April, and the labor force managed to install one-sixth of what was left. In May, one meter dropped off a truck and broke, but the usual rate of progress was maintained, one-sixth of those on hand being installed during the month. Returning from the waterworks convention at Cincinnati with a lot of new ideas, the superintendent speeded up the workers so effectively that during June, they installed one-third of those meters remaining on hand.

How many meters did the superintendent buy, how many were installed each month, and how many did he have left on hand July 1?

(Note: This problem is based on one submitted to us some years ago by the late Burt Hodgeman, and is published in this issue particularly on that account.)

Solutions:

Circumstances require that this column be written early in April, before any solutions have been received from the April issue. Answers to those problems will appear in the June issue.

WAH

SUBSCRIPTION RATES: United States and Possessions, Mexico and Cuba, $3.00. All other countries, $4.00. Single Copies, 35 cents each.

A. PRESCOTT FOLWELL, *Editor* W. A. HARDENBERGH, *Asso. Editor*

Published monthly by the PUBLIC WORKS JOURNAL CORPORATION, 310 E. 45th St., New York, N. Y. J. T. MORRIS, *President;* W. A. HARDENBERGH, *Vice-Pres.;* CROXTON MORRIS, *Treasurer. Advertising representatives,* S. N. HUME, 310 East 45th St., N. Y.; FRED R. JONES, 100 No. La Salle St., Chicago, Ill.; ALONZO HAWLEY, 1635 E. 25th St., Cleveland, Ohio.

FOUNDED IN 1896

Announcement regarding

"MUNICIPAL" VACUUM FILTERS *for* Sewage Clarification

• A new vacuum filter for sewage clarification service has been produced by Municipal Sanitary Service Corporation which is now being introduced to Sanitary Engineers for consideration and use in projects where its application may be warranted.

• The new unit embodies many improvements and has been especially designed to obtain the greatest efficiency and durability in sewage service. It is not a stock adaptation of units in unrelated industries.

• The introduction of this unit comes as the result of experiences gained during a study of operation over a period of several years at the Rockville Centre Filter Plant which was equipped by this Company. Foremost is the realization that vacuum filters for sewage clarification must be built and fitted for its particular service in order to render best results.

• The new unit is entirely of "Municipal" design. Many special features, not found in other units, have been included.

• Vacuum filter units of this latest type will be installed in the new sewage treatment plant now under construction for the Incorporated Village of Great Neck, Long Island, New York.

• This latest unit embodies an improved method of cake discharge that was developed after an exhaustive study of filter operation and maintenance costs, with the view of eliminating many of the usual replacements heretofore considered necessary.

• The new design brings into use new principles which are free from restriction of patents controlled by others formerly associated with this company, with the result that we are now in a position to offer units of higher efficiency at lesser cost.

MUNICIPAL SANITARY SERVICE

155 EAST 44th STR. CORPORATION NEW YORK CITY

Other "MUNICIPAL" Devices

Automatic Cleaners for Sand or Coal sewage filter beds, Riensch-Wurl disc Screens, Automatic Bar Screens, Pneumatic Ejectors for conveying screenings, and Incinerators for burning screenings and sludge

CO-OPERATION AND INFORMATION ARE AVAILABLE UPON REQUEST

Remember the *classified* READERS' SERVICE DEPT., pages 63-65.

PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 66 — *May, 1935* — No. 5

Water Works and Sewage Progress in the Central States

PROBABLY more progress in the furnishing of satisfactory water supplies and in treatment of sewage has been made during the past few years in the north central states than in any other section of the country as a whole; and this is especially true of the past year or two, when Federal aid and encouragement added their incentive. To obtain definite information on the subject, we have asked the several State Departments of Health to tell us of the most important work of this kind undertaken recently by cities of their respective states. The information so obtained is summarized briefly below:

Ohio

Water Purification: On January 1st, 1935, 8 municipal water softening plants were under construction, 48 were in service, and 2 had been approved by PWA. Of these 58 municipalities, 23 were cities having a total population of 808,093 (1930 census), and 35 were villages with a total population of 62,581. The smallest is Leroy, with 249 population, with iron removal from a ground water supply. Four of the recent representative water softening plants are: Hamilton, 52,176 population, lime-soda; New Philadelphia, 12,365 population, zeolite; Grafton, 935 population, lime-soda; and Worthington, 1,239 population, aeration, filtration and zeolite.

During the past two years 50 villages have installed public water supplies or now have them under construction, all but 5 as PWA projects. With these installed there will be only 18 Ohio villages of more than 1,000 population not provided with public water supply systems.

In addition to the 58 water softening plants, there are in service or under way 58 plain filtration plants, and 20 for iron removal only.

Sewage Treatment: During the past five years, 15 new sewage treatment plants have been placed in operation, 13 of them under technical supervision. In addition, 11 new plants are under contract, and 3 have been approved by PWA. Six additional plants have been rehabilitated or extended during the past five years. Altogether, 88 municipalities in the state had plants in operation in February, 1935; ranging in size from Cleveland, 900,429 served by three plants, to Leroy with 249 population; and ranging in completeness from Cleveland, with bar screens, comminutor, grease separator, grit chamber with mechanical detritor, sedimentation tank with mechanical sludge removal, two-story tank, trickling filters, secondary sedimentation with mechanical sludge removal, activated sludge with air agitation, both pre- and post-chlorination, separate sludge digestion with gas collection, and sludge disposal on covered drying beds, by mechanical filtration and incineration; to the simple plant at Ashtabula with only hand-raked bar screens and a grit chamber.

Indiana

Water Purification: On Feb. 15,th 1935, there were recently completed, under construction or being designed, 17 water works projects, most of which consisted of or included purification plants. Those completed were the plants at Huntingburg*, Jasper and Petersburg. Water filtration plants were under construction at Bedford, Hammond, Michigan City and North Vernon. Those at Huntingburg, Hammond and Michigan City were considered by State Sanitary Engineer B. A. Poole to be of unusual interest.

Sewage Treatment: Six sewage treatment plants were under construction, two had recently been completed, and plans for seven were being prepared. The plants vary in cost from Bloomington, $495,000 (20,000 population), to North Vernon, $39,000, with 3,000 population. Mr. Poole considers the remodeled plant at Lebanon and the new plants at Bloomington, Goshen and Michigan City as being the most interesting.

Missouri

Water Purification: Water purification plants were completed during 1934 by 8 municipalities; were under construction by 8 others; and bonds had been voted by one other. Of these, 9 were filter plants, 1 a recarbonation plant, 5 included iron removal, 3 softening and 1 chlorination. (These are exclusive of St. Louis, Kansas City and St. Joseph, over which the State Board of Health has no jurisdiction.) The Carthage water softening plant (to be completed about June 1) will cost about $110,000—the largest sum spent by any of the municipalities for waterwork construction; the next largest being $86,000 for a complete water system—surface supply and filter plant—for Clarence. The smallest sum was $1,400 for filter improvements by Brunswick's privately owned utility.

Sewage Treatment: During 1934, 6 sewage treatment plants were built or enlarged, in 10 other municipalities such plants were under construction but not completed, and 6 others had voted bonds for such plants. The largest sum involved (which, however, included also flood control and storm and sanitary sewers) was $1,149,000 being spent by Springfield. The next largest was $142,000 spent by Marshall for two treatment plants and outfall sewers. (A description of the Springfield activated sludge plant is given in this issue.)

*See *Public Works* for January, 1935.

Modern Water Softening Plants

Building which houses Elmore's softening plant.

Pressure Zeolite Water Softening at Elmore, Ohio

By Rollin F. MacDowell
Civil & Sanitary Engineer, Cleveland, Ohio

THE Village of Elmore, in northwestern Ohio, has recently placed in operation the first municipal automatic pressure zeolite water softening plant in the State. A brief description of the project will be of interest as pointing to the recent rapid development in the art of softening public water supplies.

Elmore is a residential community with a population of 1,100 and has an average daily water consumption of about 30,000 gallons and a maximum daily of 45,000 gallons. The water works was constructed in 1911. The water supply is obtained from three drilled wells, varying in depth from 170 to 381 feet. The shallower well is pumped with a deep-well pump of the reciprocating type and the other well by air. Both pumps discharge into a collecting basin from which the water is lifted, by means of a motor driven centrifugal pump, to an elevated tank of 40,000 gallons capacity, located at the pumping station site.

The northeasterly part of Ohio is underlaid with limestone and dolomite which outcrops in many places. This causes all ground waters, as well as the river waters, to be very hard. Iron in solution is also usually present in objectionable amounts. The Elmore wells penetrate calcium and magnesium rocks throughout their depths and the water in the three wells has a total hardness of 510 to 930 parts per million (30 to 55 grains per gallon), a high sulphates content of 375 to 550 p.p.m., a low iron content (.15 part per million), and a small amount of sulphur. Water of this character is quite objectionable for domestic use, and especially undesirable for use in boilers. It forms heavy scale in the water mains, in service pipes, meters and heating coils. It cannot be used without difficulty for the washing of clothes as the large quantity of soap required leaves a sticky curd which adheres to the cloth and discolors them. As

(Continued on page 13)

Water Works and Sewerage Progress in the Central States

(Continued from page 9)

Minnesota

Water Supplies: East Grand Forks developed a surface water supply, described in *Public Works* for April, 1935.

Sewage Treatment: Winona built intercepting sewers and a sewage treatment plant; Waconia, industrial waste and sewage treatment plants with effluent discharged into a lake used for recreational purposes (described in this issue). The treatment plant for the Minneapolis-St. Paul Sanitary District, the largest project in the state, is now well under way.

West Virginia

Water Supplies: In 1934, 22 communities completed or had under construction water works projects, at least 8 of them including purification. The most interesting of these are the work done at Fayetteville, Ripley and Tygert Valley Homesteads. (The last will be described in the next issue.)

Sewage Treatment: Pennsboro completed an interceptor and Imhoff tank plant. Spencer had under construction a plant including Imhoff tanks, sprinkling filter and chlorination. Wheeling was preparing plans for an 8- to 10-mile interceptor and partial treatment, including chlorination, estimated to cost approximately $1,000,000.

In the field of rural and mining sanitation, 55,000 standard sanitary privies were installed during the year under the charge of Dr. Fred T. Foard, U. S. Public Health Service; and the State's typhoid fever and intestinal disease death rate has shown an astonishing decrease.

Tennessee

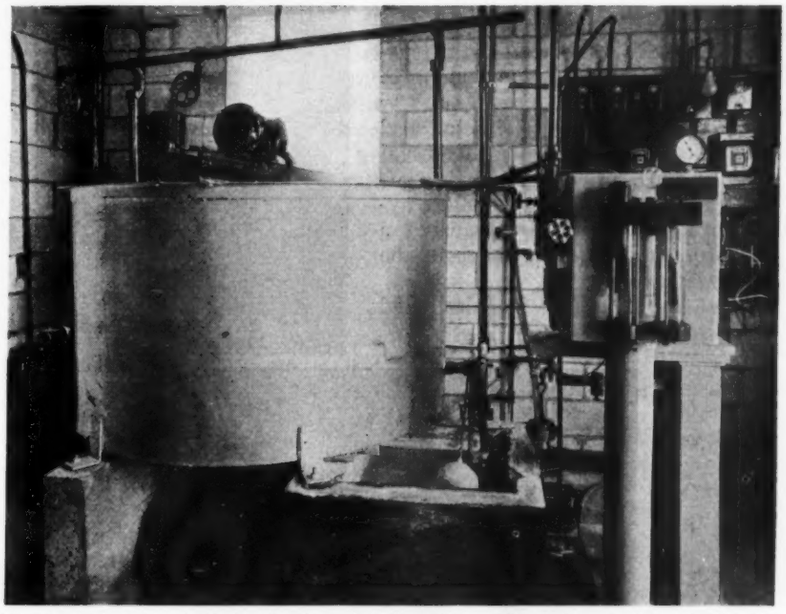
Water Supplies: PWA projects were approved for 15 municipalities, at costs from $300,000 for Nashville to $3,955 for Fayetteville. Of these, 12 were for new systems and 3 for extensions.

Sewerage: PWA projects were approved for 11 municipalities, 5 being extensions of existing systems and 6 new systems. The largest project was $450,000 for extensions at Nashville; the smallest, $7,230 for extensions at Fayetteville. From June, 1931, until PWA offered its funds, not a single major sewerage improvement had been approved by the State Health Department, and only two major water works improvements

Recently Constructed in Ohio

Lime-Soda Water Softening at Grafton, Ohio

By Rollin F. MacDowell



Chemical solution tank discharging into feed box. Electro-chemical control at left of tank near floor.

THE village of Grafton, a residential community in northeastern Ohio, although having a population of only 935 by the 1930 census, last year became one of the 59 municipalities of that state that have installed water softening plants, taking advantage of a Federal loan and grant for financing this together with an elevated tank (badly needed to provide adequate fire protection) and pipe line extensions. Because of its small population and low water works income, it was necessary to keep the cost at the minimum consistent with good results and the cost of the entire improvement was only $22,000.

The water works system as constructed in 1915 consisted of an abandoned sandstone quarry hole and two wells as source of supply, two deep-well pumps, a chlorinator, and three miles of 4″ to 8″ cast iron mains. An elevated tank could not be afforded and the system was operated with direct pressure, resulting in high fire insurance rates. The water had a total hardness of 22 grains per gallon and 1.6 ppm. of ferric oxide, and is subject to possible contamination by surface drainage.

To remedy these conditions the village has added, as stated, an elevated tank and a purification system, including softening. As the possible contamination made coagulation and filtration necessary in any event, the lime-soda softening method was dictated as giving the lowest construction cost. To keep the operating cost also at a minimum, the plant was made as nearly as possible automatic in operation in order that the one-man waterworks force could continue to take care of the system, without extra help, during the normal working hours of each day. In addition, the system is complete and up to date.

The water consumption varies from 22,000 to 45,000 gpd, average 33,000, and the new plant was designed for a normal operating capacity of 50 gpm, or 36,000 gallons in 12 hours, each of the two filter units being given this capacity. The capacity of the elevated tank is 100,000 gallons. The two original pumps had a capacity of 135 gpm each, which was reduced, by changing the gearing and motors, to 50 gpm so that they could serve as low-service units pumping directly through the plant.

The settling tank is of steel, 13 ft. diameter and 14 ft. high, with a flat dome roof, a down-take tube 3.5 ft. diameter in the center, and a semicylindrical carbonation compartment with 2 ft. radius riveted against the inside. A quick-opening valve discharges sludge to a pit and drain. This tank provides a detention period of 4.65 hours; raw water passing down the down-take tube, into and up through the surrounding tank and down through the carbonation tube to the filters. This tank is in contact with the side of the concrete block building, 18 by 27 ft. in plan, which houses all the rest of the equipment.

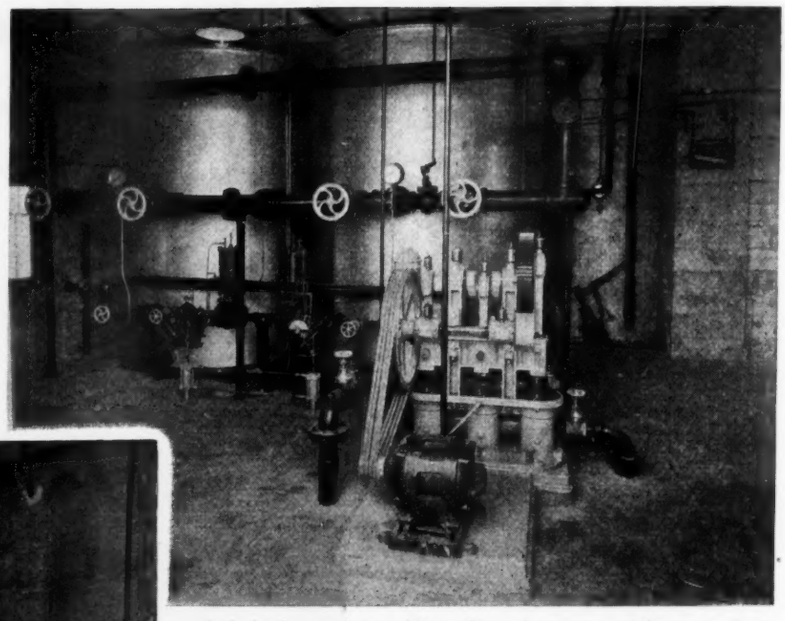
As the raw water enters the down-take it receives the chemical dose (about 100 pounds of lime and 25 pounds of soda ash a day) pumped to it in solution at a rate proportional to the flow of water into the settling tank. The solution is mixed in a steel tank 5 ft. diameter by 3 ft. high and discharged into a float box. To control the rate of feed to the settling tank, the raw water passing to this flows through an electric disc meter, rotating the meter cam, which closes a circuit each time a given volume of water passes the meter, which starts the motor of the control unit, which in turn rotates a cable drum a fixed number of revolutions and a motor cam for half a revolution, when the cam breaks the circuit, thereby stopping the motor; the process being repeated when the meter cam again closes the circuit. Rotation of the cable drum pays out the cable which lowers a swing draw-off pipe a fixed distance into the chemical feed tank, giving an accurately proportioned feed.

The carbonation equipment consists of a natural gas burner, a gas scrubber, and a Nash motor-driven compressor. The burner is an insulated steel cylinder provided with pilot, gas mixer and burner. The scrubber is a steel cylinder containing crushed limestone, on top of which is a water spray head which washes the gas

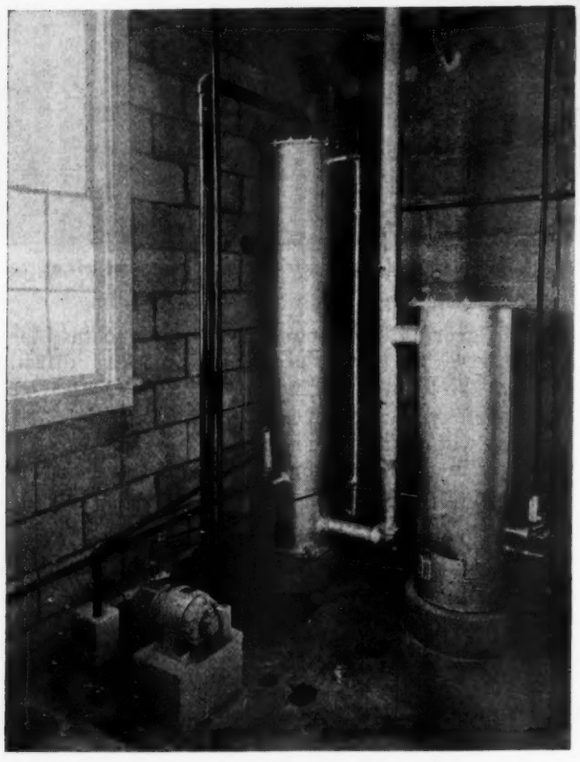
as it passes up through the stone. The compressor is of the rotary type, provided with a condensate trap to remove excess moisture from the gas. The quantity of gas being fed is indicated by a Bailey manometer type meter.

Filters. There are two circular steel filters 5.5 ft. diameter of the usual gravity type, provided with loss-of-head gauges and rate controllers hydraulically actuated by means of a float controlled by the level in the clear water basin.

The filtered water is chlorinated



Left background, two filters. Beyond recess at right, part of settling tank. On wall at right of this, chemical solution meter. Center front, the service pump. In front of filters, 3" effluent line with rate controllers. Above this, 5" filter influent.



Carbonation equipment. Gas burner at right; CO_2 scrubber in corner; CO_2 compressor left foreground.

and discharged into a concrete clear water basin of 2,000 gallons capacity providing a 40-minute detention period, from which it is pumped to the distribution system by means of a 50 gpm motor driven triplex pump.

Automatic Control. If the Grafton plan can boast of any special feature it is that it operates almost entirely automatically. A float switch at the water level in the settling tank starts and stops the low service pumps and at the same time starts and stops the gas flow to the burner, the carbonation compressor motor, the chemical feed agitator, and the chemical feed pump. Float valves control the water level in each filter, and a pressure switch, actuated by the water pressure in the high service discharge main, starts and stops the triplex service pump. Rate controllers on the filters maintain the proper level of water in the clear well. Outside of feeding approximately 100 pounds of lime and 25 pounds of soda ash to the chemical solution tank each day, the making of the routine chemical determinations, occasional backwashing of the filters and the desludging of the settling tank, very little additional attention to the plant is required. Thus the water works superintendent who operates the entire water works system (including quarterly service meter reading, flushing of mains and sewers, repairing broken mains and street service connections, and installing new services) can take care of the softening plant without employing extra labor except at times of emergency.

Financing. The water works improvements were financed by the issuance of $15,500 of mortgage revenue bonds, to which was added the Federal grant of 30 per cent. The cost of operation of the entire system, as well as the debt charges on the new improvements, will be met without increasing the water rates.

The following table gives the total cost of the Grafton improvements, of which about $5,700 was a direct grant from the Federal Government:

Softening Plant		
Building	$2,000.00	
Equipment	5,625.00	$7,625.00
Elevated tank and foundations	9,400.00	
Water main extensions	1,179.00	
Total construction cost		$18,204.00
Engineering, inspection, legal and financing charges		3,780.00
Total cost		$21,984.00

Although the plan has only recently been placed in operation, great satisfaction with the results obtained has been freely expressed by the citizens of Grafton. The improvements were designed and their construction supervised by the writer. Steinle-Wolfe Construction Company of Fremont, Ohio was the general contractor, and The Permutit Company was the contractor for the softening plant.

Pressure Zeolite Water Softening

(Continued from page 10)

a result, most of the property owners of Elmore have had rain water cisterns, with the attending trouble and expense of household pumps, dual piping systems, cleaning of cisterns and the dry-weather shortage of soft water. This situation brought about the demand for a municipal water softening plant which was finally constructed in the fall of 1934.

Improvements Made in 1934

The improvements at the pumping station, in addition to the softening equipment, consist of a new raw-water collecting basin of 45,000 gallons capacity, an addition to the pumping station housing the softening equipment; a concrete wet salt storage basin; new pumping equipment; a pipe tunnel; new pumps and a liquid chlorinator. The enlarged collecting basin permits greater elasticity in the operation of the pumping equipment and additional storage for use with a fire pump of large capacity.

Pressure Zeolite Method of Softening Chosen. The decision to use the pressure zeolite method of water softening, as compared with lime-soda, was dictated by the lower construction cost; greater cleanliness; lower cost of softening (largely due to high sulphates content of the water); elimination of lime sludge to dispose of which would have been difficult, and particularly because of the possibility of securing, with pressure zeolite, equipment for automatically regenerating the softeners, thus effecting greater simplicity of operation and the resulting reduced cost of labor for operation. Specially treated, high capacity, natural zeolite, known as "Super-zeodure," was used in the softeners in order to assure long life and continued softening efficiency. This zeolite has a guaranteed exchange capacity of 5 kilograins between regenerations.

Softening Equipment. The softening equipment at Elmore consists of two vertical steel pressure softening units, a concrete wet salt storage basin, a brine solution tank, and silica feed tanks, together with automatic valves, meters and other minor equipment. Each of the softening units is 6.0 feet in diameter by 8 feet high along the straight side, and the two softeners have a combined capacity of about 38,000 gallons between regenerations for the average water, which contains 51 grains of hardness and is reduced to 4 grains per gallon. For the present average daily water consumption of 30,000 gallons, there is thus required less than one regeneration per day for each softener.

The wet salt storage basin is built underground and is 18.67 by 18.33 feet in plan, by 6.5 feet effective depth, with a salt capacity of 80 tons. As the salt is purchased in 40 ton carload lots, in bulk, this gives a two-carload capacity, which provides proper flexibility of operation. The salt is hauled to the plant in trucks and dumped into the basin through four manholes in order to secure even distribution in the basin. The basin is filled with water and the brine solution is fed by gravity to the brine measuring tanks from an inverted dome in the center of the bottom which is covered with silical gravel to prevent the pumping of undissolved salt. The brine measuring tank, 3 feet in diameter by 4 feet high, supplies the softeners by means of a shunt ejector, electrically controlled by the automatic valves.

The silica feed, or sodium silicate and caustic soda, is used to neutralize the free CO_2 and form a slight silica deposit in the distribution system in order to prevent the soft water from dissolving the scale and iron now present in the water system. It is contained in a double steel tank, 3 feet in diameter and 6.5 feet high, from which the solution is ejected to the softeners.

Automatic Regeneration. The most important feature of the Elmore Plant is the single automatic valve on each softening unit, which automatically regenerates the softener. This is an ingenious device consisting of a multiport, single control valve, motor operated, which automatically backwashes the softener; introduces the correct amount of brine solution; rinses the excess brine to waste; and again starts the softening operation. The control valves come into operation by electrical contact after a pre-determined quantity of water has passed through a meter in the soft-water line, and regenerates through a time cycle properly proportioned for each phase of the regeneration. This period can be adjusted to suit conditions. The great advantage of this automatic device is that the softeners will regenerate at anytime, including the night hours when there is no one in attendance at the plant, and will regenerate at exactly the proper time, thus giving perfect control of the plant. This, together with the float and pressure controlled pumping equipment, keeps the comparatively small (40,000-gallon) elevated tank filled with water for adequate fire protection. Also it saves at least 45 minutes time of the water works superintendent for each regeneration of a single unit.

Costs

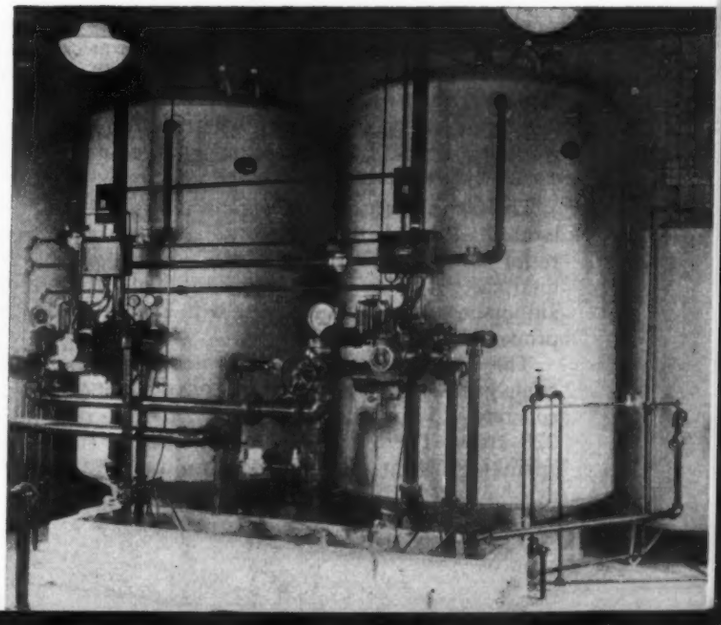
The Elmore plant was placed in operation in December 1934. The operation to date shows that an average of about 7% of the total water pumped to the distribution system is used for the combined washing and rinsing operation. The salt consumption is guaranteed not to exceed 0.45 pound per 1000 grains of hardness removed.

The construction cost of the Elmore plant was $16,300, including softener building and equipment, wet salt storage, new collecting basin, new high-service pump and chlorinator.

The yearly cost of operation is estimated at about $950, equivalent to 8.65 cents per 1000 gallons of water pumped to the distribution system.

The Elmore plant was designed by the writer. Otto Hartman, of Curtice, Ohio, was the contractor for the building and The Permutit Company for the softening equipment. Edward Weis is the superintendent of water works.

The two pressure softening units.



Curb and Gutter Built by Relief Labor at Low Cost

Placing concrete in curb and gutter forms, North Main St., Brigham City.

AS a CWA project, Brigham City, Utah, began the construction of curb and gutter improvements along its principal streets. After the CWA ended, this work was continued under ERA. These projects, and a sewer construction project carried on simultaneously were very effective in relieving unemployment in that city. The work was done under the direction of E. V. Chettle, at that time engineer of Brigham City, and of J. Wesley Horsley, mayor.

The curb and gutter constructed conformed to the general plan of the Utah State Road Commission. It was constructed of Class A concrete, reinforced, with expansion joints every 10 feet. The use of steel templets insured uniform construction, neat in appearance. Mixing of concrete was done with two 3½-foot mixers. To prevent damage from cold weather, the aggregates were preheated and the concrete covered.

The completed work was excellent in character and very satisfactory, despite the fact that an efficient working crew was never obtained. There was an insufficient number of carpenters and concrete finishers, and most of the workers were unfamiliar with this type of construction. About 40 men were employed daily, representing 15,934 hours of labor.

When CWA activities ceased, the project was still uncompleted. It was resumed shortly afterward under ERA. Before its completion, property owners had petitioned for further construction of this sort, so the work was further extended.

The methods of construction were the same under ERA, and the same excellent construction was obtained. The efficiency of the workers was relatively low. Many of the foremen had no previous experience in work of this type; but on one section where a trained general foreman, Frank Larsen, was in charge, particularly efficient work was accomplished.

The city's share of the work was high because the local ERA authorities refused to pay for essential non-relief skilled labor and for rental of equipment. The total cost was also increased by the inability of relief authorities to supply the project with an even flow of the proper kind of personnel.

The work involved in this project aggregated 679 cubic yards of Class A concrete, 294.6 yards of Class B concrete, 5,500 yards of excavation and the removal of 228 trees. There were also installed 5,416 feet of sprinkler system and 6 lighting units; 167 trees were planted. The total money value of Brigham City's contributions amounted to $11,364.29, including all items. Of this, $9,355.93 was chargeable to curb and gutter construction.

The total cost of the curb and gutter project was $24,980.55, of which national contributions amounted to $15,624.62. The total frontage of curb and gutter aggregated 7,363.2 feet, of which 847.54 feet were non-assessable.

This total cost included an indefinite amount of ERA labor on water conservation work during the severe drouth of the summer of 1934; also labor for installing the sprinkling system.

The overall cost of curb and gutter construction, including all the items mentioned, and all the ERA and CWA labor employed, at the rates paid, was $3.39 per foot, complete. On the basis of the abutting frontage only, the cost was $3.83 per foot. An adjoining section, in which curb and gutter was constructed by contract in 1922, cost $4.06 per foot of abutting frontage. It was also stated that the previous work was not reinforced and the concrete was of a leaner grade.

The engineer further reported that about $1,000 extra was spent improperly in that curb and gutter trenches were, in some cases, dug below grade and then backfilled with concrete instead of with earth; and he also stressed the necessity for trained and experienced construction foremen.

The cost to the abuttors, consisting of the straight curb and gutter work, along with incidental items, and based on local money spent on this work, amounted to 76 cents a front foot, as compared to $2.80 a foot on the previous job. Special construction to the abuttors included driveways, which were charged at 12 cents a square foot. Planting of trees cost 3 cents a front foot. The sprinkling system, chargeable to abuttors, 5,238.16 feet long, cost the property owners an additional 28 cents a front foot. Thus, the costs for frontage where planting, curb and gutter and sprinkling system were provided, was $1.07 per front foot; for the curb and gutter and planting only, 79 cents a front foot.

The cost to the city of $11,364.29 included some materials on hand, the services of the city engineer, administrative costs and equipment costs. The actual money paid out on this work aggregated $9,821.86. The city's portion of this was set at $2,340.00, leaving $7,481.46 to be met by the abuttors, which was charged at the rates given above.

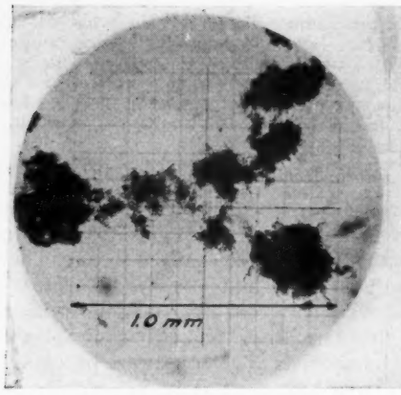


Fig. 1—Activated sludge showing flocs with typical zoogleal formations, unstained.

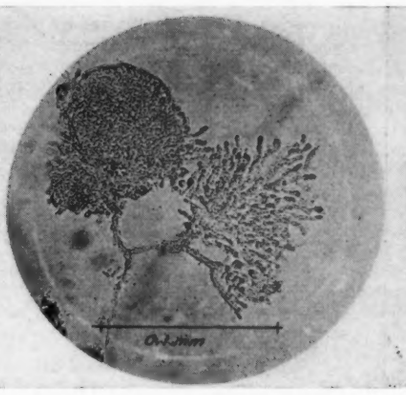


Fig. 2—Zoogleal mass from normal activated sludge floc, washed and teased free of non-zoogleal material, unstained.

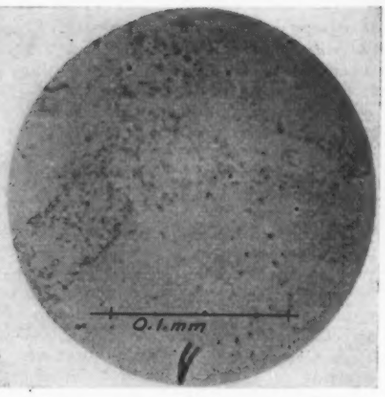


Fig. 3—Partially dispersed zoogleal mass showing bacteria both without and within the matrix, unstained.

Studies of Sewage Purification

A Zooglea-Forming Bacterium Isolated from Activated Sludge

By C. T. Butterfield

Principal Bacteriologist, Stream Pollution Investigations, U. S. Public Health Service, Cincinnati, Ohio.

RESEARCH studies on the activated sludge process conducted by the Stream Pollution Investigations laboratory of the United States Public Health Service during the past two years, under the direction of Sanitary Engineer J. K. Hoskins, have indicated that zoogleal material is regularly present in large amounts in activated sludge flocs. Each time that an activated sludge has been developed during this study, regardless of whether it was in a small laboratory set-up or in a tank of plant-size proportions, the floc developed has contained a very considerable amount of zoogleal. When the process was working most efficiently, zoogleal masses predominated in the sludge. These findings, which are in general accord with the observations made by previous workers, point to the very probable importance of this type of organism and suggest an intensive study of the zoogleal bacteria found in activated sludge to determine their characteristics and the efficiency of any sludge produced by them under pure culture conditions.

A brief synopsis of reports by earlier investigators upon zoogleal bacteria, their characteristics and role in sewage purification processes is given as a preliminary to a discussion of our own studies.

Previous Studies of Zooglea

The earliest report found that referred to zoogleal bacteria was the book of Flügge (1886) on microorganisms. Kruse, who wrote a chapter in this text, mentions zoogleal bacteria and states that Itzigsohn in 1867 was the first to observe zoogleal formations. Itzifisohn designated the specimen studied by him as Zooglea ramigera. Kruse states further that Zopf considers this Zooglea ramigera to be one phase in the life cycle of Cladothrix.

Winogradsky (1892) noted that the nitrate-forming bacteria existed both in the motile and in the zoogleal stage. He believed that the zoogleal form probably represented a resting stage. This observation in regard to a resting stage, may betrue in the case of nitrifying bacteria, but our results would indicate that under the conditions of our experiments, or in activated sludge, the zoogleal stage, while immotile, is a very active phase in terms of the utilization of food material. This observation of Winogradsky on the development of a zoogleal stage by the nitrifying bacteria would seem to suggest definitely that this type of zoogleal mass may adsorb unoxidized ammonia compounds just as the zooglea reported later in this paper removed other oxidizable material from solution. Indeed, it is not unreasonable to assume that a number of bacteria of this type which produce sludges of various adsorptive properties may be located within this group and efforts to isolate and study such organisms are indicated.

Flügge (1895), discussing the development of zooglea, believes that the zoogleal matrix is a massed exhibition of capsular substance. He states that a given zoogleal mass is generally entirely composed of the same type of cell, suggesting a pure culture. He finds that in polluted water the growth of zoogleal masses is rapid, that both spherical zooglea and a branched treelike form, called Zoogleal ramigera, are very common. His illustration of this tree-like form is quite similar to the specimen shown in Fig. No. 2. Unfortunately, no further characteristics of the organism are given. He credits Kruse with having originally assigned the name of Zooglea ramigera to this type of growth.

Stützer and Hartleb (1897) in their series of papers on the saltpeter fungi give a limited description of Zooglea ramigera. They describe it as forming spores, oxidizing nitrogen compounds, and as manifesting exceedingly variable morphological characters including a coccoid, rod and fungus-like stage, as well as the zoogleal formation. In addition, they found that in the latter stages of growth this organism would reduce both the nitrites and the nitrates which had been formed. These marked variations together with their definite disagreement with the researches of Winogradsky on the nitrifying bacteria, whose findings have since been fully substantiated, leads one to question the purity of the cultures employed by them.

Some uncertainty appears to exist as to whether the gelatinous matrix of the zogleal mass has been synthesized by the bacteria or if the bacteria are simply embedded in a chemically preformed matrix. Zooglea-forming bacteria have been investigated by various workers in studies of gum formation. Thus, in his work on Rhizobium radicicolum, Buchanan (1909) found that this organism produced a gum and existed in part as a zoogleal mass. In discussing this he states, "It seems but fair to conclude that there is a great possibility that bacterial slimes and gums are produed as a transformation or solution of the bacterial capsule." Again Buchanan (1922) defines zooglea as bacteria growing in masses of gelatinous material secreted by the bacterial cells and shows two figures demonstrating the individual bacteria.

Waksman (1927), in discussing this group of organisms states, "The gum is formed with various sources of energy in the medium, such as cane sugar, glycerol, or legume extract, and should be considered as a synthesized product."

Löhnis (1921), writing of zoogleal bacteria in general, indicates

that large encysted agglomerations of bacterial cells are not at all uncommon and implies further that the term zooglea has been so generally and so loosely used for all slimy agglomerations of bacteria, that it has lost its original specific meaning.

Theories regarding the role of the bacteria in sewage purification processes have varied from the opinion that they are essential to the process, no purification being accomplished without their activity, to the view that their presence is entirely unnecessary, the purification observed being an illustration of chemical catalysis.

Johnson (1914) was apparently the first observer to emphasize the importance of the bateria in the activated sludge process. Writing of sewage filters, he states, "The filter material rapidly becomes coated with a slimy or gelatinous growth of Zooglea ramigera, which may be regarded as a large number of bacteria embedded in a gelatinous matrix. This zooglea is perhaps the most characteristic and important organism of this zone." Again referring on this occasion to activated sludge he suggests that microscopically activated sludge repeatedly contained Opercularia and zooglea. He believes that the zooglea assisted by the protozoa are responsible for the rapid purification accomplished.

Buswell and Lang (1923) presented results on the microbiology of activated sludge and advanced a theory concerning the process. Since then, Buswell (1928 and 1931) has made extensive observations on the gross biology of activated sludge and he is convinced that the zoogleal bacteria, Zooglea ramigera, and the protozoa are of primary importance in activated sludge. The pure culture studies necessary to establish this relationship and to determine the cultural characteristics were not made. In 1928 after presenting the results of his own studies and reviewing the literature on the subject, Buswell, in summarizing, suggests the following statement as the theory of the activated sludge process: "'Activated sludge flocs are composed of a synthetic gelatinous matrix similar to that of Nostoc, or Merismopedia, in which filamentous and unicellular bacteria are embedded and on which various protozoa and some metazoa crawl and feed. The purification is accomplished by ingestion and assimilation by organisms of the organic matter in the sewage and its resynthesis into the living material of the flocs. This process changes organic matter from colloidal and dissolved states of dispersion to a state in which it will settle out."

As food material, before it can be assimilated and used for energy or be synthesized into protoplasm, must pass through the bacterial cell wall, the extent of bacterial surface available is an all important factor in studying the purification accomplished by bacteria. Buswell calculates that, considered on the basis of the zoogleal masses alone, each cubic foot of the aeration chamber contains at least 250 square feet of such surface. If the surface of the free-swimming bacteria and of the protozoa were included, he believes that approximately 500 square feet of surface would be provided per cubic foot of aeration chamber.

Taylor (1930) concurs with Buswell's theory and states, "A close examination under high powers of the microscope reveals that the bulk of the sludge is composed of jelly-like masses, in which bacteria are present in large numbers. This is a typical zooglea formation, caused by the fusion of the gelatinous sheaths surrounding the baterial cells. This zooglea is apparently the only growth in activated sludge which is a constant factor. The usual form of the zooglea is that of an irregular, lobed mass, but at times a branching, or filamentous form predominates."

Many other writers have commented on zoogleal growths in sewage purification processes without offering any specific data regarding the characteristics of these bacteria or the sludges produced by them in pure culture. Bergey (1934) in his "Manual of Determinative Bacteriology," does not list Zooglea ramigera or any bacterium with definite zoogleal characteristics. This omission is due probably to the paucity of definite evidence for the differentiation of this type of organism. Intensive effort has been directed, therefore, to the isolation and study of zoogleal bacteria from activated sludge.

U. S. Public Health Service Studies

Methods: Initial efforts to isolate the zooglea-forming bacteria were made by picking colonies from routine standard agar plates made from activated sludge. These colonies were transferred to nutrient broth, incubated with and without aeration and studied to determine the presence of zooglea formation. No such growths were obtained although hundreds of colonies were picked and examined.

Solid media containing gelatin in the place of agar were also tried without success. A special sludge agar was then prepared in which the distilled water ordinarily employed in the preparation of media was replaced with fresh sewage-activated sludge mixtures. It was thought this would supply the plating media with all of the ingredients found in the sludge where the zoogleal bacteria were known to grow well. However, although large numbers of colonies were picked and studied, no zooglea-forming bacteria were obtained.

Effort was then directed to the purification of clumps of zooglea prior to planting to render the sample suitable for examination in liquid media. Selected typical zoogleal formations, such as those in the unstained preparation from normal activated sludge, illustrated in the photomicrograph in Fig. No. 1, were picked out with sterile capilliary tipped pipettes and transferred in series through dilution waters in an attempt to wash them free from extraneous bacteria and foreign matter. This method had been successfully employed previously for the isolation of plankton. A zoogleal mass illustrating both the fingered and the solid type of formation produced by this organism, washed fairly free from extraneous material, is shown in a photomicrograph in Fig. No. 2.

In carrying out this cleansing procedure an unexpected phenomenon was encountered. During the course of the washing the embedded bacterial cells would free themselves from the gelatinous matrix and move away with incredible speed dispersing throughout the dilution water, long before a satisfactory washing had been accomplished. Such a dispersal of embedded cells is shown in Fig. No. 3. In this photomicrograph the faint outline of the zoogleal matrix may be seen with cells

(Continued on page 18)

Fig 4—Zoogleal masses stained after fixation of the matrix with mordant. In the center the matrix can be seen clearly.

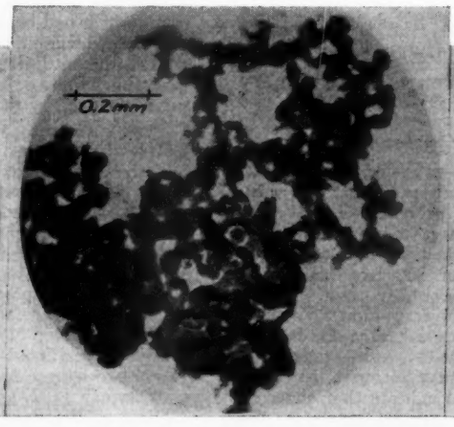


Fig. 5—Zoogleal mass from pure culture growth in broth, stained. Low power.

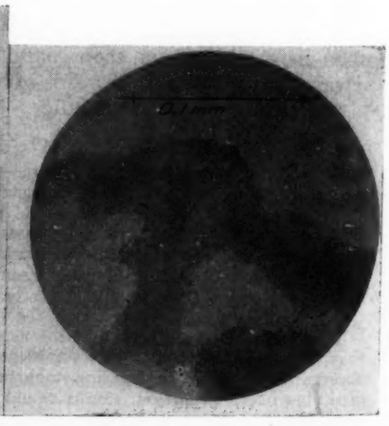


Fig. 6—Zoogleal mass from pure culture in broth. High power. Tip of floc shown in upper left of figure 5.

Paving for Unemployment Relief Paid For by Voluntary Assessments

By Frank H. Conner, Works Director, and L. C. Britton, Engineer

WHEN the Civil Works Administration was launched in November 1933, the city of Jasper, Alabama, found itself puzzled.

The relief forces had previously been used for street sweeping, cleaning ditches and such work, which was needed but was very temporary, but the city officials, as well as the director, were most anxious to put the available funds to the best and most permanent use possible.

The city had only a limited cash income and no bond margin, so after providing an addition to the city hall and various other things of that type, it became necessary to look for other permanent construction projects at a reasonable cost. The amount of government funds available for the purchase of materials was inadequate for anything approaching permanent work.

At this juncture the city secured the services of an engineer to figure some way to do paving at reasonable cost. After carefully analyzing the costs and amount of money available from the government, it was decided to do two blocks of concrete paving twenty feet wide and six inches thick, part of the cost to be paid by the abutting property. To determine this amount, the total cost for the two blocks was figured, including intersections, the government contribution was deducted, and the difference divided by the frontage owned, resulting in a figure of forty five cents per front foot, which, was collected and paid in to the city clerk before the workwas done. By using this method of handling funds, all ordinances and legal expenses are eliminated. The material available from the government was first used; then the city bought and paid cash for the remainder from the funds supplied by the property owners.

The primary purpose of the Civil Works Administration, of course, was to use labor. To do that, and to keep the cost down, local hard rock deposits were located, and rock quarried, hauled and broken into proper sizes at the site of the work, by hand. This feature is really what made the paving possible, by eliminating the purchase of slag or commercial stone for coarse aggregate. To further lower the cost it was decided to use one half local creek sand mixed with one half commercial concrete sand.

With one such project approved, work was begun. The city contributed the services of its street foreman (who is a regular employee, a team, and in addition is at present furnishing the use of a truck.

Form lumber used is obtained from a local lumber yard. The concealed center strip is made of ½"x3" wooden strips. Alternating dummy and "elastite" joints are placed every thirty feet. Wooden forms 2"x6" are used. Templets and screeds are also of wood.

Mixing is done with a one-bag concrete mixer, which is rented by the day. Concrete is put in place with two-wheeled concrete buggies, tamped, and screeded by a hand-operated screed, and finally floated with a 10-foot plow-handle float and belted. Local and state engineers have examined the work and are much pleased with the results obtained.

All grading is done by hand by relief workers, supplemented by the city's road machine.

Altogether about nine blocks of paving were poured at a cost of 45 cents per front foot to the property owners. After the success of the plan was assured, the city council voted on other projects, placing them in numerical order; when one is completed, work is begun on the next project on which the money has been deposited with the city clerk.

Since the withdrawal of government funds for material, in April, 1934, the cost to the property owners has been $1.25 per front foot. This covers all materials, engineering, mixer rent, gas for mixer, trucks, etc.

All paving laid has been twenty feet wide, six inches thick, and all projects connect paving already in existence, thus creating a network over the town.

Lack of experienced finishers on the relief rolls makes finishing something of a problem, but the finished pavement compares favorably with other concrete paving.

In addition to securing permanent improvements from relief funds, it has put private funds in circulation; as fast as one project is completed, another is ready, and property owners all over the city are most co-operative. The work is slow, naturally, but uses a maximum of human labor, while securing permanent benefits to the city.

In doing work of this nature, with the class of labor available, the importance of constant and competent engineering supervision of construction cannot be overestimated, and for economic reasons under normal conditions no city should attempt to carry on such work without plenty of equipment and skilled workmen. The purpose in view at present is to secure the most ultimate good from the expenditure of funds for relief, get private funds into circulation, and add to the morale of those receiving relief who prefer to work for it, even if not skilled along these lines.

Jasper's population is slightly under six thousand; with the men assigned to work relief for the city, ten blocks were paved under the CWA program and eleven blocks have been paved to date under the ARA, with three more blocks approved to begin work on. In addition, dirt streets have been maintained, school grounds improved, ditches cleaned, and three concrete and several wood bridges built.

Following the example of Jasper, the town of Cordova has paved six blocks, and Dora three blocks. Both of these towns are in Walker County and did their paving with the writers as engineer and works director, respectively.

Directing all of the paving in Jasper are L. C. Britton, city engineer; Frank H. Conner, works director of the Walker County Emergency Relief Committee; John G. Burton, Mayor, and R. F. Kilgore, street foreman.

Studies of Sewage Purification

(Continued from page 16)

scattered without as well as within its limits. In Fig. No. 4, such a gelatinous zoogleal matrix, which has been fixed with a mordant and stained, may be clearly observed. Observations made subsequently appeared to suggest that the embedded bacteria feed on nutrient material absorbed by the gelatinous matrix and then when it is cleared of such material by repeated washing they leave the matrix possibly in an effort to find sufficient food.

It was found that this dispersing action could be prevented by the addition of a considerable amount of dissolved organic material to the wash water. Ten cc. of sterile nutrient broth to 90 cc. of dilution water proved to be satisfactory for this purpose. Using such a water a zoogleal mass could be washed through 10 to 12 changes of water until it was entirely clear of extraneous material and apparently free from contaminating bacteria. The clump was transferred at this time to normal dilution water and changes in such water continued until dispersion of the cells occurred. This suspension was then placed in a measured amount of sterile dilution water and planted on standard agar plates and in serial dilutions in standard lactose broth.

No colonies containing zooglea forming bacteria were obtained from the agar plates. In fact, only a few colonies of any kind were observed and they were confined to the one cc. and the one-tenth cc. plates made from the original suspensions. Growths of zooglea-forming bacteria were obtained from all broth tubes up to and including the 1-100,000 dilution from tubes incubated at both 20 and 37°C. The growths obtained appeared to be in pure culture in all tubes above the 1/100 dilution. This process was repeated several times and plantings were made in each case from the highest dilution showing growth, with intermediate washing in dilution water, to insure the purity of the culture before intensive studies were undertaken. The photomicrograph shown in Fig. No. 5 portrays a typical growth taken from one of these broth cultures. The granular nature of this floc is clearly illustrated in the figure. In Fig. No. 6, a portion of the floc found in the left center section of Fig. No. 5 is shown under higher magnification. Here the bacterial nature of the floc can also be observed. This culture was designated as Z-1.

A second isolation, using the same procedure, was made from a normal activated sludge produced in another series of experiments. The organism isolated at this time was apparently identical in all respects with the bacterium obtained from the first isolation. This culture was designated as Z3.

After experimental results, reported later in this paper, had shown that this zoogleal bacterium was probably of especial significance in sewage purification and in the activated sludge process in particular, a detailed study was made of the conditions favoring the growth of this organism and of its characteristics.

(To be concluded)

Concrete pavement laid by relief forces. Old asphalt pavement in foreground.

Activated Sludge Plant at Springfield, Mo., with Some Unusual Features

By Joe Williamson, Jr.
With Russell & Axon, Consulting Engineers, St. Louis, Mo.

AN ACTIVATED sludge plant is now under construction at Springfield, Mo., which will serve an area in the northwest portion of the city which now has a population of 8,000. The present sewage flow to be treated averages 0.72 m.g.d. and the maximum is 1.08 m.g.d., but the plant is designed for an ultimate population of 12,000, contributing a sewage flow of 1.08 m.g.d. average and 1.62 maximum.

The plant consists of an overflow or by-pass chamber; a control house; two primary sedimentation tanks; a digester equipped with heating coils, domes for gas collection and sludge recirculation pipes; two aeration tanks; a final sedimentation tank; and sludge beds, with provision also for the lagooning of sludge. The primary tanks and the aeration tanks are of double units, to provide flexibility in operation and some treatment in the event of a machinery breakdown.

Throughout the design every effort was made to locate, within the control house, all details requiring attention, such as pumps, motors, sludge diversion boxes, meters, etc.; with the idea that concentration of equipment promotes efficiency in operation. The raw sewage enters, and the treated liquor leaves, the control house; and both the raw sludge and the activated sludge are handled there so that samples for test purposes may be taken in close proximity to the laboratory.

The main features of this design differentiating it from the ordinary activated sludge plant which may be of interest are the handling of the sewage through the plant by gravity, and pumping *after* treatment; the precautions which are taken to prevent flooding of the plant by excess flows or backwater; and the provisions made for sludge drying either on beds or by lagooning.

The plant is located in a valley which consists of bottom land with steep rock bluffs on both sides,making a site above high water impractical. This bottom land is subject to overflow two to three months of the year, and levees are constructed around it to protect the site from flooding. By providing float-controlled pumps for raising the effluent it is possible to operate the plant by gravity when the water in the creek is normal and pump only at high water stages. Even at this stage an economy is effected by this method, because the pumps will operate against the actual high water level only, while with primary pumping it would be necessary to lift the sewage at all times into a plant located above the maximum high water.

Normally all of the sewage flow enters the plant and is treated. The capacity of the outfall sewer is 20 c.f.s. while the maximum sanitary sewage flow for which treatment is provided is only 1.62 m.g.d. or approximately 2.5 c.f.s. In times of heavy rainfall the infiltration into the sewerage system is large but at that time the flow in the creek is almost sufficient to adequately dilute the sewage without treatment.

In order to control the flow through the plant, a diversion chamber was designed ahead of the control house in the outfall sewer. An overflow weir or by-pass arrangement would solve the problem as long as the water level in the creek remained below the level of the weir. But during floods the outfall sewer flows under pressure and the level of the raw sewage in the diversion chamber is at a height of four or five feet above the desirable flow line for the primary sedimentation tanks.

To meet the above conditions the walls of the grit chamber in the control house were carried up above high water elevation and a rate-of-flow controller was located in the pipe line between the grit chamber and the primary sedimentation tanks. The controller is so designed as to prevent a flow greater than 1.62 m.g.d. and is capable of adjustment so that this maximum flow may be held to a capacity of as low as 1 m.g.d. As a minimum loss of head through the plant was desired, the venturi type rate-of-flow controllers as used for waterworks installations was investigated. It was found that, on account of head loss, the usual rated capacities for such tubes would have to be ignored and it was decided to use a 14 in. venturi tube. This tube also actuates the sewage flow meter mechanism located on the operating floor of the control house. In view of the fact that some method of measuring the sewage flow, such as a venturi meter, would have been included in the plant equipment, the only additional mechanism to obtain the required control was a hydraulically operated 14 in. gate valve.

For screens and the disposal of the screenings, twin comminutors manufactured by the Lakeside Engineering Company, which shred the solids and floating matter in the raw sewage and aid in the prevention of clogging of the venturi tube, were installed at the end of the grit chamber. These comminutors were arranged to operate either alternately or together, each being of sufficient capacity to handle the average sewage flow.

As the city owns the land in the valley for a half mile below the plant and a well defined overflow channel traverses nearly the entire distance through the overflow bottoms, the first intention was to dispose of the digested sludge by lagooning; but it was feared that this method of sludge disposal might become a nuisance, and sludge beds were provided. These beds have an area of only ¾ sq. ft. per capita of ultimate population, but provision has also been made for draining any or all of the sludge into the overflow channel so that experimental work may be carried on to develop the efficiency of lagooning before the connected load makes its use a necessity. In the event that lagooning does not prove satisfactory, additional sludge beds may be built adjacent to the present ones to provide the additional area required.

Another interesting feature in connection with this plant was the method of handling the letting of the contracts. After the general design of the plant had been completed, a notice was mailed to the various manufacturers of sewage treatment equipment stating that bids would be received by the city for future delivery of equipment for an activated sludge sewage disposal plant. This notice outlined the number and capacity of the various units required, with sufficient data for definite proposals from each of the manufacturers.

The bids for machinery were received and compared

(Continued on page 22)

Circular purification plant assembly. In the outside angular space is the covered filtered water reservoir; the next annular space is the coagulating basin; inside are the four filters; and in the center is the control house. The high-service pumping station is in the background.

Operating Results at the Burnt Mills Purification Plant

By Robert B. Morse

Chief Engineer, Washington Suburban Sanitary District

THE Burnt Mills water purification plant of the Washington Suburban Sanitary District will, when completed, have a rated capacity of 10 mgd and will include aerators, preliminary sedimentation reservoir, head house and raw water pumping station; also two assemblies each containing a coagulating basin, four filters, filter control house, pipe vault and filtered water reservoir, all in circular concentric units; and a high-service pumping station in which are chemical machines and laboratory, and a small hydro pumping plant and high-tension sub-station.

The most unusual feature is the design of the two assemblies, each of 5 mgd capacity, and constructed entirely of steel. A steel cylinder 24.5 ft. diameter contains the operating piping and supports the control house on its top. The annular space between this and a concentric wall 54.25 feet diameter is divided by radial walls into 4 equal parts, each containing a filter. The coagulating basin occupies the space between this and another concentric wall 72 ft. diameter; and between this and the outside shell, 100 ft. diameter, is the filtered water reservoir. (See PUBLIC WORKS for August, 1934). This reservoir is roofed over and the central pipe well is protected by the control house, but the other two annular spaces are open to the weather. Another innovation is the floor of the filter which is composed of "Tri-Lok" galvanized copper-bearing steel grating in radial sections. which supports directly the 16 inches of graded gravel under the filter sand.

Effect of Subzero Weather

One of these 5 mgd assemblies was placed in operation early in May 1934, fed by gravity until the raw water pumping plant was started in December. It has therefore been in operation almost a year, including a winter during which the temperature fell to —18° F, with sustained average minima of—14.5° for two consecutive days, —5.8° for five days, —2.4° for ten days, 1.9° for fifteen days, 6.7° for twenty days, 14.8° for forty days and 19.7° for ninety days. The effect of this low temperature is described as follows by Robert B.

Morse, chief engineer, Washington Suburban Sanitary District. "No difficulty was experienced in operation and no damage occurred to the steel structure, not even any appreciable scratching of the paint from the effects of ice movement. Ice reached a thickness of 22 inches on the coagulating basin and a maximum of somewhat more than 11 inches before it was removed from the single filter on which it had been allowed to collect. On the exposed sides of the coagulating basin and filtered water reservoir ice gathered on the steel work to a thickness of four inches, but practically none formed on the surface of the water in the filtered water reservoir.

"Around the inlet to the coagulating basin the water surface remained clear of ice at all times, and the thickness over the outlet cone having its lip 24 inches below the surface was never enough to interfere with the flow. The rise and fall of the water surface was sufficiently continuous to prevent tight ice adherence to the steel plating, and the constant flow of water in the basin resulted in a mushy ice formation which, although very thick, disappeared much more rapidly with the arrival of moderate weather than did the thinner ice sheets covering the Burnt Mills reservoir and the preliminary sedimentation reservoir.

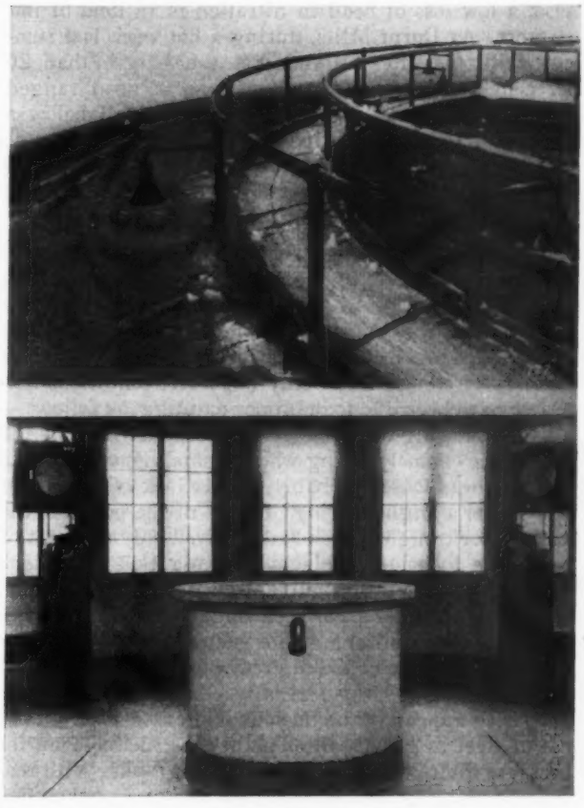
"On three of the filters, ice was allowed to form only to such thickness as it would between washing operations. This was at no time more than 1¼ inches owing to surface movement of the water, and freezing occurred only slightly except at temperatures of 10° or lower. Just previously to washing a filter, unless the ice was so thin that it would break up of its own accord when the water level dropped to the elevation of the wash troughs, the operator or a laborer would break the ice sheet with a pole sufficiently to allow it to pass off to the downtake and thence to the drain during washing. The time consumed by this operation varied from three to ten minutes.

"Wherever long-continued periods of sub-zero minimum daily temperature are not of ordinary occurrence, uncovered filters are economical, and it is possible to operate them even under persistently severe conditions with a small additional expenditure for labor and with increased frequency of washing during the worst weather, particularly if washing operations are concentrated in the night hours when temperatures are usually lowest."

Result of Treatment

The water to be treated varies in turbidity from 5 ppm to (on one occasion in June, 1934) 12,000 ppm, when it rose from 30 to 5,000 in 40 minutes. It is aerated by Aer-O-Mix machines (supplemented when necessary by blowers) and passes through a preliminary sedimentation reservoir, is pumped to coagulating basins and then filtered. In the raw-water pumping station four dry-feed machines apply alum, soda ash (when necessary) and activated carbon to the water; the last, just before the water is pumped to the coagulating basins. In the high-service pump room are three dry feeders, one for applying lime to the filter effluent, one for alum when the water by-passes the sedimentation reservoir, and the third for activated carbon when it is desired to feed this direct onto the filters.

The 5 mgd assembly which has been in service for twelve months has given complete satisfaction. During the last six months the filtered water turbidity has averaged 0.1 ppm, reaching a maximum of 0.5 ppm on only two occasions, although raw water turbidity averaged 41 ppm, with a maximum of 1500. Color of the filtered water has averaged 0.6 ppm, reaching 3 only three



Above. Open filters and coagulating basin in operation during sub-zero weather. Below. Filter control house; filter effluent stack and sight well in center. At each side, one of four valve-control operating stands

times and a maximum of 5 on two occasions, while the raw water has averaged 50 ppm. The quantity of wash water used was rather large before the preliminary sedimentation reservoir came into service, on account of experimentation with rates, the short period in the coagulating basin, unusually high prevailing turbidities during the summer of 1934, and the many filter-washing demonstrations given before visitors. Excellent results are now obtained at a rate of 12 gallons per square foot per minute, and with the consistently low turbidity of the effluent from the preliminary sedimentation reservoir the amount of wash water now consumed is low (1.7 per cent in March).

"Where a raw water is highly turbid at times yet ordinarily of low turbidity during dry weather, a considerable saving in the consumption of chemicals may be made, and greater stability of plant operation secured, by providing for preliminary sedimentation and the use of a smaller coagulating basin than would be otherwise desirable. When the water is cold and floc formation is slow, coagulating chemicals may be added at the entrance of the preliminary sedimentation basin; extremely high turbidities may call for a dose at that point and another before the water enters the coagulating basin; and at other times preliminary sedimentation alone will relieve the water of enough of its turbidity to allow a low and relatively even dose of chemical at the entrance of the coagulating basin. This is the routine at Burnt Mills.

"The compact arrangement of the filter assembly and its piping, and the type of filter bottom employed, result in exceedingly small losses of head during both filtering and washing operations. In this design, therefore, either a lower wash-water tank or smaller wash-water piping than ordinarily provided may be used.

Also, a low loss of head in filtration is an item of importance. At Burnt Mills, during a hot week last summer, with the filters running at times more than 20 per cent above normal rate, the loss of head ranged between 4 and 7.2 feet. Water did not fall below a depth of 6.3 feet in the filtered water reservoir and rose to a maximum of 9.5 feet, which is only three inches below the overflow. The bottom of this reservoir is at the same elevation as that of the filter chambers.

Durability of Steel in Filter Plants

"No deterioration of the steel work in the plant can be found at the end of the first year of operation. The alum-treated water has no visible effect on the steel in the coagulating basin and filter chambers, nor on the wash water troughs. The only imperfect conditions discerned have been due to improper painting, as follows—a slight showing of bare steel at the upper limit of the bitumastic enamel coating where a small amount of this material was loose, probably due to lack of primer at this point; a slight scoring of some of the paint on the wash water troughs which had received only one coat of paint due to haste in placing the plant in operation; scaling of the paint on galvanized doors and railings, which might better have been ungalvanized; and blistering of the unsuitable white enamel paint which was used on the inside of the filtered water sight well in the control house.

"There appears to be no sounder reason to avoid the use of steel in gravity filter plant construction than for pressure filters, standpipes, or elevated tanks. With reasonable painting maintenance, the life of a steel assembly of the Burnt Mills type should be practically unlimited, and painting should not be necessary any oftener than in the case of standpipes, except for wash troughs and for brightening outside surfaces, in order to maintain a continuously high state of presentability. The possibility alone of reproducing the original condition of the surface at any time by painting gives steel a great advantage over reinforced concrete for filter plant construction, as will be evident when one remembers the sad appearance and state of disrepair of many concrete structures connected with water works.

"Burnt Mills itself furnishes striking evidence of the durability of steel for filter plants. For eleven years two 125,000-gallon steel tanks, one serving as a coagulating basin and exposed to alum-treated water and the other as a filtered water reservoir, were half buried in the ground without protection. Inside surfaces were painted initially, and outside surfaces above the ground had received one coat of paint since. These tanks had seen about six years of service previously as coagulating basins before being torn down and re-erected at Burnt Mills. When they were finally removed, to make room for the present works, the steel plates and shapes, even those which had been below ground, were in sufficiently good condition to have served indefinitely at a new location. Again—four smaller steel tanks, new when erected, served for six years as coagulating basin, filters, and filtered water reservoir in an extension of the temporary water purification works at Burnt Mills. These were also partly buried in the ground and received only slightly better painting treatment than the others. The steel was in excellent condition when the tanks were removed. One of these tanks now serves in another location as a ground reservoir in a town water system, while one of the wash water tanks at the new Burnt Mills plant was built out of the steel from the others.

"From the standpoint of compactness the arrangement of units used at Burnt Mills is all that could be desired. As noted previously this 5 mgd assembly occupies a circle exactly 100 feet in diameter. Aside from mere arrangement of the constituent parts, the use of steel is a factor in compactness since practically no area is consumed in wall thickness. Marked economy in cost of construction resulted both from the design of the assembly and the material of which it was built. The steel work erected but unpainted, including the control house complete, cost approximately $25,000, or $5,000 per mgd, while the total cost of the assembly, ready to run, including excavation, foundations, "Tri-Lok" grating, painting, all piping, valves, control stands, rate-of-flow gauges, lighting, heating, and filter sand and gravel in place, amounted to approximately $50,000, exclusive of engineering and overhead expense, or $10,000 per mgd. Under present conditions the expenditure might reach $65,000 or even $70,000, eqivalent to $13,000 or $14,000 per mgd.

"The total cost of the project, including supply line, pumping stations, preliminary sedimentation reservoir, hydro plant, sub-station, second 5 mgd steel assembly, retaining wall along stream, roads, walks, grading and planting, and lighting of grounds, will be aproximately $375,000, or $37,500 per mgd, exclusive of engineering and overhead expense.

"A steel filtration plant of the Burnt Mills type will not cost, ordinarily, more than from 60 to 75 per cent as much, depending upon capacity, as an equivalent conventional reinforced concrete plant. One using the same arrangement of units but constructed of reinforced concrete would show a considerable saving over the conventional type, though not as great as if built of steel.

"A study of the first year's operating results leads to the opinion that it will be entirely feasible to run the Burnt Mills works continuously at a rate of at least 12.5 mgd, for which capacity all piping and other waterways were designed to give low hydraulic losses. Even before the preliminary sedimentation reservoir came into use, the filters and coagulating basin exhibited excellent results at 25 per cent above normal rating when raw water turbidities were not unusually high.

"All of the construction work at Burnt Mills, except the steel filter assembly, which the Chicago Bridge and Iron Works furnished and erected, and the installation of the steel framework, "Euboeolith" floors, "Corkoustic" insulation, rock lumber partitioning, flashing, weather-stripping, and slate work for the buildings was accomplished by the day labor forces of the Washington Suburban Sanitary Commission."

The above is condensed from a paper by Mr. Morse before the Four-State Section of the American Water Works Association.

Activated Sludge Plant at Springfield

(Continued from page 19)

on the basis of plant cost and operating and maintenance costs. The most economical type and manufacture of equipment was definitely decided on and detailed design of the plant was then completed based upon the actual type of machinery selected. Into the specifications were written the prices submitted by the successful equipment manufacturers for guidance of the general contractors bidding. This method of handling the project worked out to the complete satisfaction of everyone concerned and eliminated the expense and confusion of preparing various alternate plans.

The project was financed by the Public Works Administration and the details of specifications and lettings were worked out with their approval.

Sewage and Industrial Waste Treatment at Waconia, Minnesota

By H. O. Halvorson and Randolph L. Smith
Department of Bacteriology and Immunology, University of Minnesota

WACONIA, Minnesota, a city of about 1200, is located on the shores of Clear Water Lake, which has a perimeter of approximately 10 miles and is used extensively for fishing, bathing, and other recreational purposes. It is particularly noted for bass fishing. Previous to the completion of the new sewage plant, the city was served by a combination sewer which carried all the domestic waste to an Imhoff tank. The effluent, following chlorination, was allowed to flow into a bay of the lake. There is also located at Waconia a rather large creamery to which farmers of the surrounding community bring their whole milk. Butter is made from the cream, and the skim milk is used for the production of condensed milk, skim milk powder, and casein. The waste from the creamery was disposed of in the lake, through a separate sewer, without treatment.

During the dry weather of the past few years, the lake level dropped at an alarming rate, and the pollution became more and more marked. In years of normal rainfall, the lake overflows through a natural outlet into a neighboring lake, but during the past four or five years the level has been so low that there has been no overflow. The sewage was discharged near the outlet, so that under normal conditions a great deal of the organic matter was carried into the neighboring chain of lakes. The dropping of the lake level thus further aggravated the situation. The pollution of the lake became more and more serious, and objections were raised by visiting sportsmen and citizens of the community. This led to an investigation of the extent of pollution which was carried out over a period of a year during 1932-1933.

Surveys were made of the industrial and domestic wastes, as well as of the lake itself. It was found that about 20,000 gallons of domestic sewage was being poured into the lake. This had an average B. O. D. of about 250 before entering the Imhoff tank. By means of preliminary treatment and chlorination the 5-day B. O. D. was reduced to about 120. A study of the creamery waste showed the desirability of separating this into three portions: 1—condenser water from the milk evaporators; 2—regular creamery waste resulting from wash-ups, milk spills, etc., and 3—whey resulting from casein manufacture. The condenser was operated from one to ten hours per day, and during that time the flow amounted to 15,000 gallons per hour, with a 5-day demand of about 25. The regular creamery waste varied in volume from 5,000 to 10,000 gallons per day, and had a 5-day demand of from 200 to 800, with an average of about 500. The volume of whey (which was produced only when casein was manufactured) varied from 500 to 1,800 gallons, with a 5-day demand from 17,000 to 30,000. It is apparent from this that the nature of the composite creamery waste could vary considerably from day to day. On some days the flow was found to be as low as 5000 gallons with a 5-day demand of around 500; while on other days it was as high as 15,000 gallons with a 5-day demand of 7000.

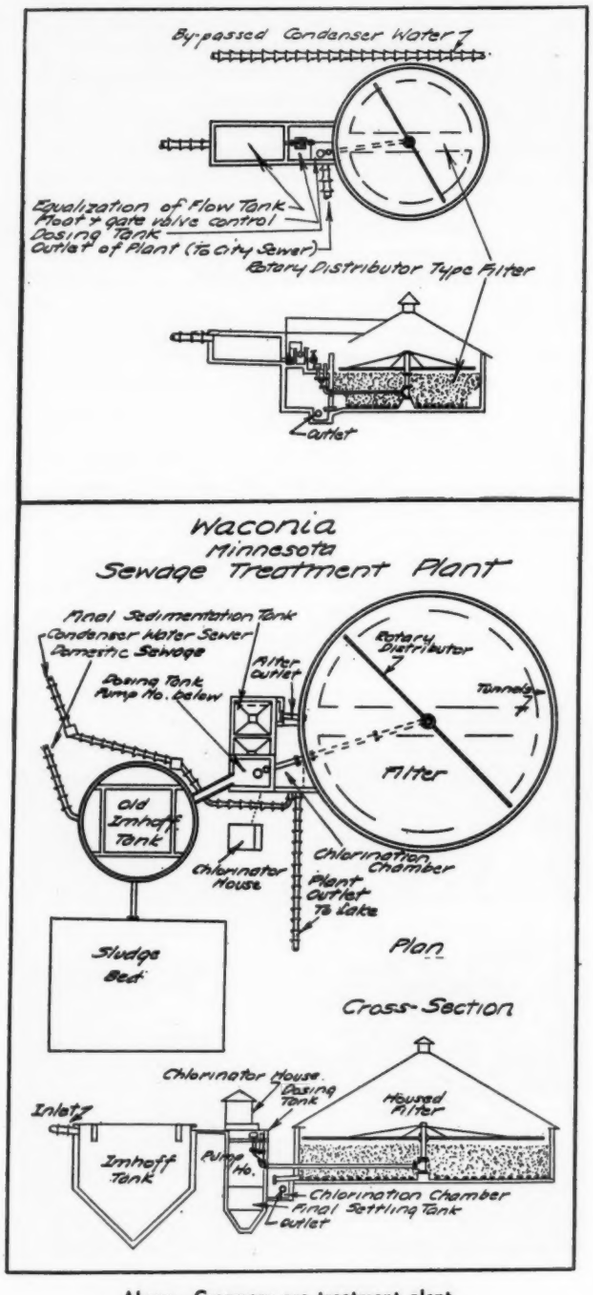
The survey of the lake revealed that the water in the bay in which sewage was being dumped had an appreciable oxygen demand. This was less noticeable in the summer when the volume of waste introduced was somewhat smaller and the rate of self-purification greater. Samples removed from various stations in the bay showed that the lake water frequently had a 5-day demand as high as 25, and at several stations the dissolved oxygen was below O. Determination of dissolved oxygen was always made at 4 o'clock in the morning, when the picture was not confused by the liberation of oxygen from growing algae. It was found that during the summer months the lake water was invariably saturated with oxygen during the day, due to the extensive growth of algae. During the winter, when the lake was covered with ice and a much larger volume of stronger sewage was being introduced, the condition was much worse. At many stations there was no dissolved oxygen and the water had a pronounced odor. At several points in the bay, the 5-day demand of the lake water was nearly as high as that of ordinary domestic waste.

The survey further revealed that elimination of the creamery waste alone would not rectify the situation. The lake was being polluted by both creamery and domestic waste, and a complete solution of the problem involved treatment of both.

The creamery is located about a half mile from the

Above—Creamery pre-treatment plant.
Below—Municipal treatment plant.

Imhoff tank, and this fact had a considerable bearing on the method of treatment finally resorted to. It was considered advisable to make use of the available Imhoff tank in the new design. It was found to be large enough to accommodate the regular creamery waste in addition to the domestic sewage, but it was considered dangerous to put the raw creamery waste directly into the city sewer and allow it to flow into this tank, as this would undoubtedly cause an acid condition and foaming. We therefore decided that the best solution would be to pretreat the creamery waste in a separate plant, and allow the effluent from this plant to flow into the city sewer. The Imhoff tank did not have capacity sufficient to treat all the creamery waste, including the condenser water, so a separate sewer was constructed to carry the condenser water directly from the creamery to the new city plant without treatment, allowing it to by-pass the Imhoff tank, and also the city filter, if desirable.



Above—Creamery pre-treatment plant.
Below—Municipal treatment plant.

Because of the high demand of the whey, we found that drying was a much more economical method of disposal than the building of a sufficiently large plant to allow for its treatment.

The problem then resolved itself into the construction of a pretreatment plant to handle the regular creamery waste, and a secondary treatment plant for the city sewage.

The Pretreatment Plant

The accompanying sketches show the general construction of the two plants. The creamery pretreatment plant consists of a rock filter 35 ft. in diameter with an 8 ft. depth of gravel rock graded from 1½ to 3 inches, onto which the sewage is sprayed by means of a 2-arm rotary distributor fed from a small siphon tank with a capacity of only 100 gallons, so the filter may be dosed almost continually during the day. The filter is preceded by a 5000-gallon equilization tank, the flow from which is controlled by a float valve, so that the flow into the dosing tank is practically constant during the time the creamery is in operation. The equalization tank also serves to withhold some of the waste, so that the plant can be made to work 12 hours a day, whereas the creamery is in operation only about 8 hours. At night there is no operation because there is no waste coming from the creamery.

After the flora had developed on the rock in the pretreatment plant, we found that the 5-day demand was reduced by 85-90 per cent while passing through the filter. The filter unloads more or less continually, but no provision is made for the removal of settleable solids at the creamery. Instead they are carried into the city sewer and are removed in the Imhoff tank. It was found that pretreatment removes the carbohydrate completely, and the Imhoff tank has been operating normally, showing no signs of foaming.

The Municipal Plant

For the municipal plant, a bed of 55 ft. diameter was constructed with a 7 ft. depth of gravel rock of the same size as was used in the creamery bed. The plant is equipped with a 2-arm rotary distributor, which is fed by a small siphon tank having a capacity of only 300 gallons. Here again, the dosing tank is small enough to keep the filter operating continually during the periods of heavy flow. The effluent from the filter goes to a final settling tank constructed in two sections with hopper bottoms, each section being 8x8x8 ft. The sludge settling in this tank is pumped into the raw waste as it enters the Imhoff tank, so as to provide an inoculum for the influent. The effluent leaving the final settling tank flows into a small detention chamber where it is chlorinated; it then flows to the outlet sewer, which carries it into the lake.

When the flora had developed on the rocks in the filter, it was found that the 5-day demand was reduced 90 to 95 per cent as calculated from the demand of the raw waste entering the Imhoff tank to the effluent flowing into the lake. The condenser water was allowed to by-pass both the Imhoff tank and the filter; but provision is made for the treatment of the condenser water by the filter in case it is desirable, and tests showed that allowing the large volume of condenser water to flow through the filter did not decrease the efficiency of the plant, and

(Continued on page 26)

Laying 60-inch pipe.

Coating field joint.

Thirteen Miles of Large Steel Mains Laid by St. Louis

Less than a gallon per-inch-mile leakage

By C. M. Daily

Water Commissioner, St. Louis, Mo.

THE $12,000,000 bond issue in 1923 for a new water works plant, at Howard Bend on the Missouri river, was expended for a plant of an ultimate capacity of 160,000,000 gallons per day, but the plant, with the exception of the intake, engine pits and boiler house, was constructed for approximately one-half that capacity. The filter plant and basin were designed for 80 m.g.d. and the pipe line to Stacy Park for 60 m.g.d. The reservoir at Stacy Park has a capacity of 100,000,000 gallons, with an outlet of 60 m.g.d. to the city distribution system.

In order to take advantage of the storage capacity at Stacy Park and draw upon it for peak loads, a second 60-inch main was under consideration early in 1933, and with the thought of getting a grant from the P.W.A. of over $300,000 it was decided to prepare plans, specifications and estimated cost for this pipe line, consisting of:—

46,895 ft. of 60″ main, steel shell ½″ thick, or concrete shell 5½″

11,015 ft. of 54″ main, steel shell 7/16″ thick, or concrete shell 5″

9,985 ft. of 48″ main, steel shell 7/16″ thick, or concrete shell 5″

The usual estimate was made giving the man-hours material costs for the various items, and formal application was made for the "grant." In due time the grant was allowed, and detailed plans and specifications were prepared and accepted by the P.W.A. The three types of pipe we specified were:

1. A steel welded pipe, plain ends, in 40′ lengths, connected by means of Dresser couplings.
2. Reinforced concrete pipe, Lockjoint cylinder type.
3. Prestressed reinforced concrete pipe, without a cylinder, connected by means of Dresser couplings.

On March 16, 1934, bids were received for furnishing the pipe in a yard in St. Louis, and for hauling and laying the pipe. Bids for furnishing steel pipe were received from seven contractors, the prices varying from $10.64 to $13.003 for 60″; from $8.90 to $10.185 for 54″; and from $7.94 to $9.58 for 48″; the total amounts varying from $676,277 by the McClintic Marshall Corp. (of Bethlehem, Pa.), to $810,011 by the Babcock-Wilcox Co. (of New York City). The Lock Joint Pipe Co. bid, for their type of pipe, $10.75, $10.10 and $9.25 for the three sizes, a total of $707,734; while for the same type, G. L. Tarlton, St. Louis, bid $11.50, $11.50 and $10.00 respectively. For the pre-stressed type the only bidder was the Minder Const. Corp. and Boaz-Kiel Const. Co., at $18.92, $17.55 and $15.80 for the three sizes—a total of $1,238,429.

The laying contract included 19 items, of which the largest were 150,000 cu. yds. of excavation (bid $0.54 to $1.30); hauling and laying 60″ pipe (bid $1.05 to $5.44 for concrete, and $1.25 to $2.69 for steel); 54″ pipe (bid $1.05 to $6.08 for concrete, and $1.20 to $3.42 for steel); 48″ pipe (bid $1.05 to $6.08 for concrete and $1.15 to $3.35 for steel). There was also 2,000 cu. yd. of rock excavation (bids $3.00 to $12.00); removing and replacing 34,800 sq. yd. of concrete, asphalt, brick and macadam pavement. The total bids for laying ranged from $336,403 to $569,004 for steel, and from $394,342 to $807,577 for concrete.

The low and successful bidders were: McClintic-Marshall Corp., Bethlehem, Pennsylvania, for furnishing welded steel pipe in 40′ lengths, and Dresser couplings for field joints; and Spiniello Construction Co. of

Newark, New Jersey, for hauling and laying the pipe.

Both contracts were awarded March 23 and McClintic-Marshall Corp. notified to begin work as soon as the contract was signed; but Spiniello was not notified to begin work until August 28th, a delay of three months, due to difficulties in selecting the coating for the steel pipe.

The specifications provide that the pipe is to be coated at the yard in St. Louis with a coal tar product, on the inside by the spinning process, and the outside coating applied by means of a nozzle moving forward while the pipe slowly revolves.

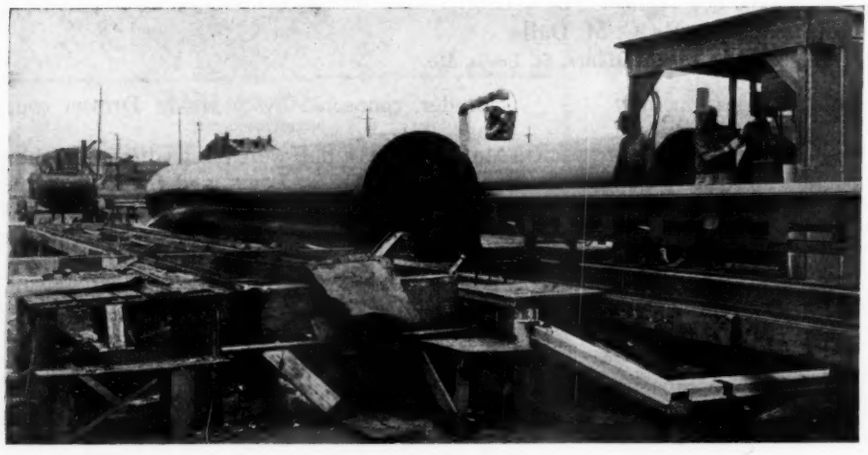
The thickness specified for the inside coating was 1/8", with a tolerance of 1/16"; the thickness specified for the outside coating was 3/32" with a tolerance of 1/16".

McClintic-Marshall Corp. let a sub-contract to Johns-Manville Co. for coating the pipe. The apparatus for coating the pipe was improved by replacing the steel rollers with solid rubber tires, and in a few weeks the contractor was producing a very satisfactory coating. However, coal tar has a narrow range between the cold flow temperature and the temperature at which the material will become brittle, and this range can be varied to higher or lower temperature by the addition or omission of coal tar oils.

Work progressed very satisfactorily from September 1st until November 15th, when it was closed down by an order from the P.W.A. which was caused by some of the coating peeling off the pipe before laying, following a sudden change in temperature on October 28th and 29th. The difficulty was adjusted the 1st of January, but the work was not resumed during the winter months. Nothing has developed in the coating to lead an engineer to believe that it would not be satisfactory. The coating forms a perfectly smooth interior finish.

The joints, which are made up of Dresser couplings, have been tested on that portion of the line which has been laid, amounting to about 18,000 feet. The average leakage amounted to less than a gallon per inch of diameter per mile of pipe in twenty-four hours.

Work is expected to start again in April, and the work will probably be completed by the first of July, 1935.



Coating inside of pipe.

Sewage Treatment at Waconia

(Continued from page 24)

we are therefore convinced that the plant is adequate for the treatment of the condenser water whenever it is found necessary to do so.

Result of Treatment

Since the installation of the treatment plants, conditions in the lake have improved materially. There is no longer any odor nuisance, and the water shows no evidence of pollution.

The following tables give typical data obtained in studies made on the efficiency of the plants. Table I gives data on the creamery plant. The values obtained before April 14 are not indicative of the efficiency of the plant, since these were obtained before the proper flora had developed. After the plant was put in operation, it became apparent that the volume of creamery waste had increased; instead of 5,000 to 10,000 gallons of waste, as found in the preliminary survey, there were frequently from 25,000 to 30,000 gallons. Table II gives data from the final survey of the city plant.

The samples were all composited by sampling the sewage in proportion to flow every 15 minutes, over a 12-hour period in the case of the creamery plant, and over a 24-hour period in the case of the city plant.

The creamery plant was financed by the creamery at a total cost of about $6,000. The municipal plant and condenser water sewer were financed by the city, with the aid of the PWA, at a total cost of about $18,000.

Table I. Creamery Plant

Date	5-day B.O.D. in parts per million: Raw Waste	Unsettled effluent	Settled effluent	Over-all reduction	Total volume
Feb. 21	950	..	950	0	
March 2	215	..	145	32.6%	
March 12	520	..	260	50.0	
April 6	318	..	129	59.4	
April 14	735	..	92	87.4	
April 23	620	..	62.5	90.0	
July 27	171	31.5	11.2	93.5	29,087 gal.
Aug. 6	500	41.8	29.3	94.0	25,029 gal.

Table II. Municipal Plant

Date	5-day B.O.D. in parts per million: A	B	C	D	E	Over-all reduction	Total volume
June 29-30	155.5	116.5	..	..	3.9	97.5	48,987
July 10-11	228.0	170.0	..	..	11.2	95.0	42,404
July 20		115.0	..	..	9.0	92.2	
Aug. 8- 9	130.0	98.0	16.5	10.8	3.1	97.5	53,650

A.—Raw sewage. B.—Effluent from Imhoff tank. C.—Effluent from filter before final sedimentation. D.—Effluent after final sedimentation, before chlorination. E.—Final effluent following chlorination.

The Editor's Page

Costs of Constructing Public Works With Relief Labor

Engineers can generally be counted on to do the right thing when it comes to professional work; often, however, they say the wrong things when it comes to telling about their work. We have personally heard a good many engineers in charge of the construction of public works under the ERA lament over the general inefficiency of the work. The metropolitan newspapers quite often quote directing engineers as saying that waste is inevitable in such projects.

Waste to the engineer represents the difference between the attainable and the ideal; to the newspaper reporter, the politician and the man on the street, it often means gross inefficiency. There is no comparison between these. They mean totally different things.

Most of this talk about waste is bunk. In a great many of our cities, counties and states, construction work is being done, using relief labor, at costs comparable to those of ordinary construction procedures. On another page of this issue is an excellent report of curb and gutter work, on which the total costs compares very favorably with the costs of this type of construction anywhere. Yet in that report, the very able engineer giving it devoted considerable space to comments on the general inefficiency of the work and of the workers.

A reservoir construction job in New York showed excellent costs. A lot of other instances could be cited; in fact, there are a number of articles in this office, scheduled for early publication in this magazine, which illustrate how many communities have found their engineers able to combine the conflicting requirements for relief and of economical construction of needed and useful public projects. In the article referred to previously, the net cost to abuttors for curb and gutter work was 76 cents a front foot, as compared to $2.80 a foot before ERA, CWA or the other alphabets were heard about. It certainly pays cities to utilize relief funds for construction.

A word of advice to the engineers: Don't apologize; don't explain; let your work—the finished job—speak for itself.

Are Engineers Human?

Into this office there flows from engineers a steady stream of letters, all with practically the same tenor: That the relief administration will not, or cannot, recognize the necessity of the engineer in construction work for unemployment relief. As one man writes: "An engineer has to be down to his last dollar before he can be given any work, and in the meantime engineering work is being done by men without engineering licenses, often without a shred of engineering training."

There are at least three points to be considered here. The most important one, which is aside from any interest we may feel in other enginers as humans, is that a whole lot of preliminary engineering work is necessary before unemployment relief can function in a manner to produce any return for the money spent. There is a stubborn—yes, dumb—refusal on the part of many of those in charge of relief to realize the absolute necessity of engineering work before construction can begin.

Second, proper design calls for good engineering. It takes an engineer to design an engineering structure. And it often takes a specialized type of engineer. Office engineers, computers, draftsmen, transitmen and designers are all needed. Perhaps an office could get along with four or five transitmen by assigning two or three of them to drafting, computing or designing; but there is an inevitable waste in such an arrangement.

Similarly in construction. Good supervision of the work is necessary for sound and economical construction. This requires men with construction experience.

Relief administrators should bear in mind these factors when the matter of engineering employment comes up. By doing so, they will secure structures of which they can be proud; and they will accomplish far more worth-while work.

Also, to speak bluntly, a lot of cities and counties have been passing the buck on this very point. In their unwillingness to spend any money themselves, they have acquiesced to an astonishing degree in this unsound procedure. Pleading poverty, they have tried to compromise with relief officials. The result has been that engineers invariably have been underpaid; in many cases they haven't even been employed.

Springtime and Highways

Pleasant spring days are too apt to remind the highway engineer that it is time for maintenance work to repair the ravages of winter. It is, quite likely, also the season for indignant rural residents to complain of muddy and rutted, even impassable roads, that prevent them from hauling farm produce to the market; or even shuts them in their homes.

Scientific progress in road building has made it possible for many of these rural roads to be transformed into hard surfaced roads, travelable all the year around. This can be done at a very low cost. Local materials, properly graded, with calcium chloride for a binder, produce good roads at astonishingly low cost. Asphalt and tar roads are also cheap to build and easy to maintain. And all such road building helps to relieve unemployment and bring back a greater degree of prosperity.

Novelties in Water Purification Plants

A few years ago the structural features of filter plants seemed to have been standardized in all except minor details. Rectangular concrete boxes arranged on opposite sides of a pipe gallery under an operating floor, with an operating table opposite each filter unit; sand size fixed within fairly narrow limits; wash water applied through grids, etc. But recently engineers have questioned the finality of those standards. In this issue of PUBLIC WORKS we have, we find, without intentionally doing so, assembled a number of such changes. Filter boxes with steel walls forming an annular ring around the pipe chamber; filter bottoms of non-corrosive steel grating in one case, and in another of porous plates such as are used for air diffusion in sewage aeration; coarser sand (coal in a few plants); electrically operated filter valves controlled from a central switchboard; these are but a few of the innovations recorded in this issue alone.

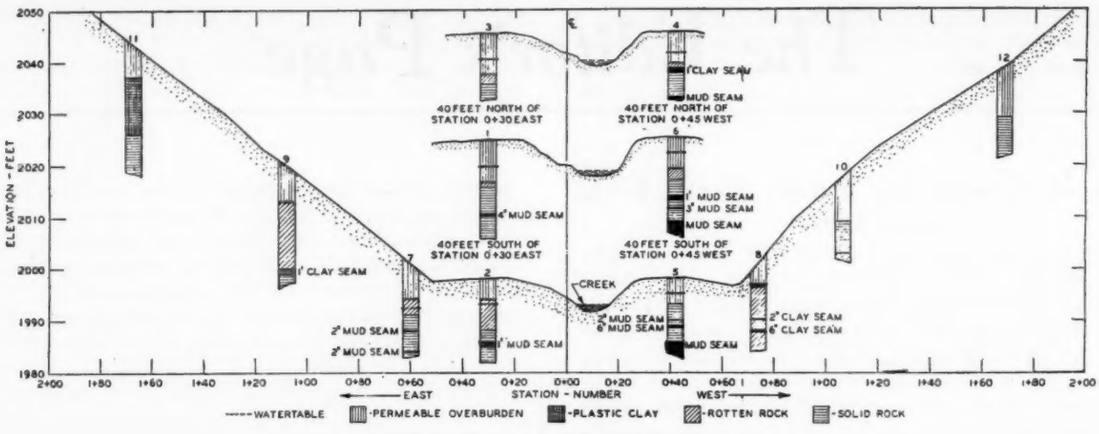


Fig. 2—Cross-section of dam site showing test pits

Soil Technology in Earth Dam Construction As Employed in Back Creek Dam

Reported by C. A. Hogentogler, Jr.
Soils Technician, U. S. Forest Service

THE Back Creek earth dam was constructed by the U. S. Forest Service as part of a recreational project located along the north fork of Back Creek, about 15 miles south of Waynesboro, Augusta County, Virginia. In its design and construction were employed the latest principles of soil technology relating to earth dam construction.

Design Features

The first consideration was to provide an ample spillway. With weir readings and flood predictions as a basis, a spillway 35 ft. wide was excavated in solid rock and separated from the fill by a concrete wall. To lower the reservoir water during floods, a 36 in. concrete drain pipe was constructed at the base of the fill, to which the water is admitted by means of a flood gate controlled from a concrete tower; both pipe and tower being founded on solid rock.

The three major causes of earth dam failure are erosion (due to wave action and possible overtopping), leakage, and slides. To prevent the first, rock riprap was placed on both slopes, and rock wastage reinforced both toes. To insure against detrimental leakage, selected fill material of low permeability, properly compacted, was used. To prevent slides, slopes were provided which gave a large margin of safety.

The embankment as designed has a maximum width of 225 feet at the base, a maximum height of 30 feet, is 8 feet 6 inches wide at the crest, and required 25,000 yards of compacted material. There are two berms, one on the upstream side which serves as a foundation for the riprap, and one on the downstream side which serves as a foundation for the riprap and also as a gutter for drainage. The slope on the upstream side is 3:1 from the ground level to the berm and 2½:1 from the berm to the top. The slope on the downstream side is 2:1 throughout. (In the finished structure the base is actually much wider than planned, because rock from the spillway excavation has been wasted at both toes.)

The fill was constructed by placing material in layers 6 to 8 inches thick and compacting with a sheepsfoot roller. The material for the main portion of the embankment was selected to give a homogeneous structure having low permeability. Wasted material from the spillway excavation of somewhat more porous character was used to a limited extent on the downstream side.

Soil Examinations

Preliminary soil examination furnished the data which assisted in the selection of the final location of the dam and suggested certain design features. As part of the construction procedure, examinations were made of the character of the natural foundation soil and of

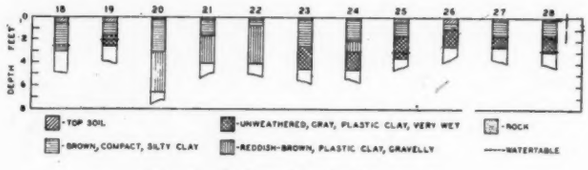


Fig. 3—Soil profiles in borrow pit

the borrow pit material, and determinations of the moisture content and degree of compaction were made during the placement of the material in the fill.

Test pits were used in the examination of the natural soil and star drillings used to explore the underlying rock. A visual examination disclosed that the foundation under-soil was a very loosely compacted sandy loam which was interspersed with gravel deposits, and which, as it approached the rock line, blended into a mixture of sand and gravel. The water table was within two feet of the surface in some places and the rock line was at an average depth of 10 feet.

The drillings, which were carried to a depth of 12 feet, indicated about 3 feet of rotten rock underlain by a very hard quartzite, which was stratified and contained mud seams from less than 1 inch to a foot or more thick and filled for the most part with a very wet, plastic clay (although in pits 5 and 6 gravel or mud was encountered).

Terzaghi compression tests of the permeability of both undisturbed and disturbed samples of the foundation soil showed this to be low enough to indicate that, this soil, although satisfactory for use in the embank-

GIVE 'EM THE WORKS..
On any road—on no road

On your job—on every job—on paved highways—where there are no roads at all—Goodyear Truck Tires perform better. They wear longer—more economically, because Goodyear builds truck tires specifically for each type of hauling job to be done.

For your dump trucks, Goodyear builds the Dump Truck All-Weather. It has that famous ground-gripping All-Weather tread that bites down and holds wherever your trucks go. It has an extension of the tread down the side walls for traction in soft going—for protection against cutting and scraping over sharp rocks and rough surfaces. It has a Supertwist cord body with special chemically-toughened rubber. That means strength for the heavy loads and hard pulls. It has Goodyear's new extra-strong bead construction to withstand the strains caused by heavy swaying loads on rough ground.

Goodyear Dump Truck All-Weathers are built to do the kind of work your dump trucks do. They'll do it better—more economically. Let them prove to you they're MONEY SAVERS.

THE GOODYEAR TIRE & RUBBER COMPANY, INC., AKRON, OHIO

CALL THIS MAN

He is the Goodyear Truck Tire Man. He represents the most complete line of truck tires made. Behind him are all the years of Goodyear's experience in the design and application of truck tires for every type of business—for every job. He'll pick the RIGHT tires for your trucks. His services cost you nothing. He'll save you money.

SEE THIS TIRE

It's the famous Goodyear Dump Truck All-Weather. It's the most scientifically designed tire built for dump truck work. It represents years of experience in tire building by the world's largest builder of truck tires. It's a MONEY SAVER.

GOODYEAR TRUCK TIRES—MONEY SAVERS

ment if disturbed and compacted, would be too permeable in its undisturbed state. To have removed and recompacted the 13,000 cu. yd. of soil over the entire foundation area would have necessitated an expenditure which it was decided to avoid by limiting the percolation by means of a relatively narrow cut-off trench carried to ledge rock and backfilled with selected material. This trench, located 30 feet south of the centerline, is 18 feet wide at the bottom, and has side slopes of 1:1.

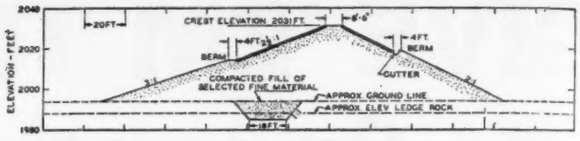
Selection of Material

The first step in the selection of the fill material was to dig test pits at a location in the reservoir site which, from the standpoint of construction, was considered the most desirable location for the borrow-pit. These test pits were made just large enough for a man to work in and were carried to rock, a depth of less than 6 feet in most cases. Visual examination of these pits furnished data on the rock line, water table, and depth and character of soil layers; the color, texture, percentage of gravel (whether rocky, fine, etc.), compactness and degree of saturation being recorded on a soil profile.

By means of approximate gradings of all material available at the reservoir site, representative samples of material were selected and tested to learn which had the properties required in the dam embankment. Samples of those materials which had the desired characteristics were then tested for compaction characteristics required during construction.

In grading the soils, samples of all the different soil

Cleaning out and sealing mud seams in bottom of cutoff trench



Above: Fig. 1. Showing the cross-section of the dam. Below: Procedure in compacting the material in the cutoff trench

layers in each test pit were removed to the field laboratory, spread on boards and allowed to dry in the air, and then pulverized and passed through a No. 4 sieve to determine the percentage of rock. Enough of the soil passing this sieve to give 50 grams of thoroughly dried soil (corrected for hygroscopic moisture) was first mixed with water and allowed to soak overnight. This mixture was then washed into a 1,000 c.c. cylinder, a deflocculating solution and 15 grams of lead shot were added, and the mixture shaken vigorously for five minutes. Water was then added to increase the suspension to a total volume of 1,000 c.c. and the mixture was again shaken for five minutes. After periods of 50 sec. and 1 hour respectively, hydrometer readings were made for the purpose of determining the approximate silt and clay contents.

This mixture was then washed through a No. 200 sieve and material retained on the sieve was dried to constant weight, weighed, and transferred to a glass bottle of about a pint capacity, which was connected by flexible rubber tubing to a 30 c.c. burette. The system was then filled with water, the bottle was shaken for one minute, and the soil allowed to settle in the burette. In order to eliminate the tendency of the soil to stick in the tube, the burette was mounted on an electrical buzzer which was used to slightly jar the apparatus while the soil was settling. The volume of the sediment was read at given time intervals.

On the basis of the approximate gradings so made, 8 representative samples were selected for further examination by means of a combined compaction and expansion test.

To be concluded in the June issue

In the next issue, Mr. Hogentogler will describe in detail the procedures and equipment employed in making compaction tests, will outline control during construction, give results of subgrade tests, and tell of construction methods.

Water Light and Power

A Special Section in PUBLIC WORKS *magazine devoted to the interests of publicly owned utilities.*

The new building housing the water, light and power plant

Horton's reservoir, "Mission Lake," 200 acres area

Horton, Kansas, Municipal Light and Power Plant Gives Good Service at Low Cost

By H. L. Lingo

Superintendent of Water and Light Department

IN THE twenty-four years since 1911, when the city of Horton, Kansas, bought for $55,000 the privately owned water and light utility which had been serving it unsatisfactorily since 1895, it has built up a plant with a value of $529,739, all from the earnings of the plant. The Water and Light Department has a total of $56,500 of serial bonds outstanding because the holders will not sell them, but this is more than offset by $77,500 of bonds (mostly school and city) which it holds, together with $7,843 cash on hand, and other assets bringing the total to $632,730.

In addition, the department has given the city services, valued in 1934 at $12,000, such as current for the sewage plant, lighting streets and city hall, and salaries of the city clerk, treasurer and other employees.

This has been done without charging high rates for water or light. For the former. the rates are 50 cts. per M for the first 10,000 gals. per month, 40 cts. for the next 10,000, 30 cts. for the next 30,000, and 20 cts. for the next 50,000; with a 50% reduction for all over 5,000 gals. during the three summer months to encourage keeping lawns green. Light rates are 5 cts. for the first 100 kwh. per month, 4 cts. for the next 300, and 3 cts. for all over 400. Heating, 3 cts. per kwh. Power, 5 cts. for the first 100 kwh., 4 cts. for the next hundred, and 3 cts. for all over 200.

The station cost of electric current was 9 mills in 1934, and that of water was 6 cents per thousand gallons. The total amount of current generated was 1,773,-870 kwh., or 10.1 per gallon of fuel oil. The total amount of water pumped was 109,571,000 gallons.

The city has a population of 3,500 and is governed by a mayor and two commissioners, who appoint a manager or superintendent to operate the utilities, including water, light and sewage (and also do any other work they can think of).

The water supply is obtained from a 700 mg. reservoir, formed by damming a stream, which is called Mission Lake and used as a recreation spot for boating, fishing, hunting, picknicking, etc.; part of the department's income being from fishing, hunting and boating permits. Here fireplaces and free wood are provided.

The water is filtered, 17,700 pounds of alum and 8,000 pounds of lime being used in 1934. Of 50 analyses made that year, 40 pronounced the water "excellent," 8 "good" and 2 "fair." (The ultra-violet ray method of sterilizing the water was used for a few years, but discarded in January, 1933, as being too expensive).

The private company had used a small D.C. plant, with one tubular boiler and one engine belted to a 25 kw. generator. In 1913 the city installed a 400 hp. Corliss steam engine. In 1921, due to the high cost of fuel, a 400 hp. vertical-type Diesel oil engine was bought and installed for $45,000, and in 1923 a similar type Worthington Diesel of 562 hp.; and the demand so increased that a third Worthington Diesel of 600 hp. was added a few years later.

In 1930 a new building 65 by 95 feet was erected around the old one at a cost of $19,000, which not only furnishes ample room for the three engines but also permits of expansion. The old boilers used for the steam plant have been removed and the space used for a small vertical boiler for heating the building, water filters and pump house, and also for a small machine shop for making repairs.

Cooling water for the engines, after leaving the cylinders, is run through three clear wells of the old water system and then over a Marley cooling tower built over a fourth well, from which it is pumped back to the engines.

The three engines and the floor are painted battleship gray and all are kept spotless. The walls have been painted with aluminum paint except for a 4 ft. black dado.

The yard immediately around the plant has about two acres of grass and flowers, the latter including almost every kind that is grown in that part of the state. With the eight-acre lake as a background the layout is very beautiful and is the pride of the citizens of Horton.

RUBBERIZED COVER

We welcome an opportunity to quote on your requirements.

Safety First!
BUILD WITH STEEL CASTINGS

Manhole Covers
Catch Basin Grates
Curb Inlets
Monument Boxes
Manhole Steps and other Steel Castings

NOISELESS, DURABLE HIGHWAY CASTINGS

THE WEST STEEL CASTING CO.
CLEVELAND, OHIO

Water Filters and Filtration Plant Equipment

for Domestic and Industrial Service

SWIMMING POOL FILTERS AND RECIRCULATING PLANTS

EQUIPMENT FOR SEWAGE TREATMENT PLANTS AND PUMPING STATIONS

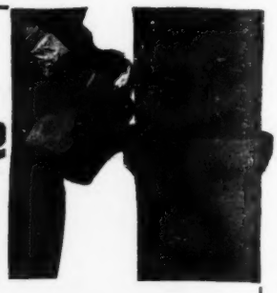
We serve as skilled contractors to furnish and install the complete equipment, piping, etc., in all forms of water and sewage plants.

ROBERTS FILTER MFG. COMPANY
640 COLUMBIA AVE. DARBY, PENNA.

This man is pouring

SERVICISED

REG. U.S. PAT. OFF. © 1918



PIPE JOINTING COMPOUND

FOR BELL AND SPIGOT SEWER PIPE

It's a wise man who uses SERVICISED Pipe Jointing Compound for SERVICISED produces a joint that is tight, flexible, economical, absolutely waterproof, impervious to weather or soil conditions and prevents root growth or other infiltration problems.

Simple to heat and apply, SERVICISED Compound can be applied by ordinary laborers. Further information on request.

© 1920

Asphalt Plank
Expansion Joint
Waterproofings
Asphalts
Fibre Plaster
Sheet Asphalt Waterproofing
For Sewer Tunnels

Write us about our SEWER PIPE BELT.

SERVICISED PRODUCTS CORP.
6051 West 65th St. CHICAGO, ILL.

REDUCES PUMPING COSTS

USES LOCAL LABOR

IMPROVES FLOW IN ANY MAIN

MAKES MAINS AS GOOD AS NEW

BACKED BY 27 YEARS EXPERIENCE

Use Relief Labor to *Clean Your Water Mains* By The NATIONAL METHOD

INCRUSTATION forms so gradually that often people do not realize its extent until an investigation shows how much the city can save by restoring the efficiency of its mains.

It will pay you to look into the possibility of cleaning your mains this summer by THE NATIONAL METHOD. This work can be done quickly and economically by your local relief labor under the expert supervision of one of our experienced superintendents.

Why not get the facts now. We have prepared an interesting, illustrated booklet, "The Cleaning of Water Mains," which we shall be glad to send on request. Write for your copy today. THE NATIONAL WATER MAIN CLEANING CO., 50 CHURCH ST., NEW YORK, N. Y.

Send for FREE Booklet

The National Water Main Cleaning Co.
50 Church St., New York, N. Y.

Without obligation, please send me your illustrated booklet, "The Cleaning of Water Mains."

Name .....

Title .....

City ..... State .....

THE NATIONAL WATER MAIN CLEANING COMPANY

NATIONAL METHOD

When writing, we will appreciate your mentioning PUBLIC WORKS.

Constructing a 10-Mile Pipe Line With Relief Labor

Laying 13-foot lengths of 8-inch pipe with relief labor

A FOUR-YEAR drought created a serious water situation in Ordway, Colo. This town, which has a population of 1,200, with 1,000 others living nearby, is in the center of an irrigated district of 56,000 acres. There are two separate water systems—a sanitary system used for fire protection, lawn sprinkling, irrigation, toilets and baths, and a drinking water system. The sanitary supply is obtained from the Arkansas river through an irrigation ditch 47 miles long, which also supplies irrigation water to the district. The drinking water was supplied by a private company.

Because of the drought, practically no water has been obtained for irrigation purposes from the Arkansas river during the past four years, and very little was obtainable for drinking purposes. The town secured a PWA loan of $90,000 to put in a new distributing system and to enlarge the storage capacity of the reservoir, but when this was done it became evident that an additional supply would be needed for both sanitary and drinking systems. Only 8,000 gallons per day was being supplied by the water company, part of which had to be used for supplying farmers in the vicinity. Many shallow wells were put down, but the water from them was not fit for human consumption. Approximately 75% of the population were on relief because of the prolonged drought conditions.

Eleven miles northwest of the town some wells had been put down about 25 years ago. These produced good water of considerable quantity, and after a study of them, it was decided to clean them out and construct a pipe line to connect them with the town. The FERA agreed to purchase the materials and furnish the labor for constructing the line, while the town agreed to furnish the pumping equipment.

Transite pipe was selected because of its economy and also because it was easy to lay with the unskilled labor at hand. Plans called for an 8-inch line. Seven ¾-inch McCracken air pressure and vacuum valves, three blow-off valves and one cut-off valve were placed in the line; also a check valve near the junction with the 12-inch line into the distribution system, to prevent the water from the reservoir backing up into the new line when the pump was not running.

Construction Details

The trench was excavated to a depth of 56 inches to give about 4 feet of cover. The ground, which is a hard adobe, was loosened with a plow drawn by a "60" tractor, and the loose dirt then removed, after which it was again plowed, etc., until the desired depth was obtained. Pipe laying started at the end near the town. Only relief labor was used and a crew of 6 men laid an average of 90 lengths, 1,170 feet, of pipe per 8-hour day. Four men on this crew made the connections, two working in the ditch and two on the surface. Two connected lengths were lowered into the trench at a time. One man was employed digging bell-holes in the trench ahead of the pipe-laying. The sixth man lined up the pipe behind the connecting crew and placed dirt around the joints so they would not move.

The unskilled laborers were fully capable of laying this pipe quickly and economically.

Improving the Wells

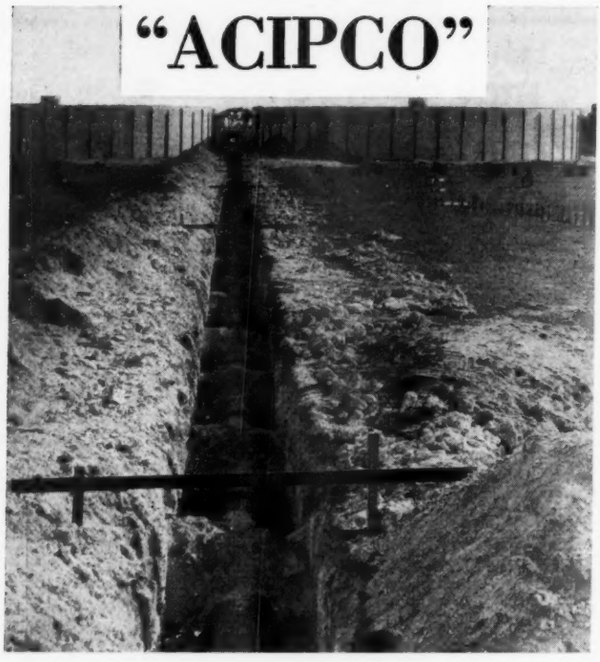
The work at the wells consisted of sinking a casing 6 feet in diameter approximately 25 feet through sand and gravel to a shale bedrock. Inside of this temporary casing a 30-inch perforated casing was placed and the area between the two was filled with clean fine gravel. The outer casing was then removed. Three wells were improved, all being connected with a 6-inch wrought-iron suction header system, and a foot valve was placed on the end of each suction pipe. The pump and engine were placed in a building at well No. 1. The pumping machinery consists of a 2-cylinder, 4¼ x 6-inch, 4-cycle, 20 hp. diesel engine belted to a centrifugal pump delivering 250 g.p.m. against a 100-foot head at 1,450 r.p.m.

Progress of Work and Costs

Work started July 22, 1934. The first carload of pipe arrived on August 1 and laying began on Aug. 6. Work at the wells was carried on simultaneously with pipe line construction. Pumping into the line started Sept. 29. Not a single leak developed in the line, though there were some minor leaks where the Transite pipe was connected to cast iron specials with cement. When Mineralead was used for this work, no leaks occurred.

The costs were as follows:

Labor, 8" Transite pipe, etc.	$54,194.25
Specials, valves, etc.	1,500.00
Equipment rentals, gas and oil and tractor operator	1,773.52
Pump, engine, fitting, cement, etc.	3,425.21
Salary of Engineer (Town of Ordway)	450.00
Total cost	$61,342.98
Cost per foot, all charges	$1.10



Miami, Fla., is now installing cast iron pipe to replace a 7-mile water supply line composed of a substitute for cast iron pipe which failed after only 11 years service. PWA funds are financing the project. Accompanying photo shows 30-inch Mono-Cast Centrifugal Pipe leading to the new concrete reservoirs. For literature on this pipe write American Cast Iron Pipe Co., Birmingham, Ala.

Carolina Crest Hotel

A BEACHFRONT HOTEL JUST OFF BEACHFRONT

ON BEAUTIFUL NORTH CAROLINA AVE., ATLANTIC CITY

SERVING A *Tray Breakfast* TO YOUR ROOM ANY TIME UP TO 11 O'CLOCK WITHOUT ANY CHARGE FOR BREAKFAST OR SERVICE.

EVERY ROOM HAS PRIVATE BATH
AND AT LEAST THREE LARGE WINDOWS

SINGLE AS LOW AS $2.50
DOUBLE AS LOW AS $5.00

Free Bath Houses for Ocean Bathing

WRITE FOR WEEKLY RATES AND GROUP RATES

FAIRBAIRN, INC.

When writing, we will appreciate your mentioning PUBLIC WORKS.

Jointing pipe outside of trench

Separate costs were not kept on trenching and pipe laying. The hours of labor include all labor used in connection with trenching, hauling and laying the pipe, sinking the wells, installing suction lines, constructing the pump and engine house and installing the pump and engine.

About 300 gallons per minute are being distributed through the pipe line, providing a per capita supply of 360 gallons per day. The operating cost for fuel, lubricating oil and attendance amount to $8.25 per million gallons.

The data covering this project were furnished us by L. G. Truehart, chief engineer, Colorado Emergency Relief Administration.

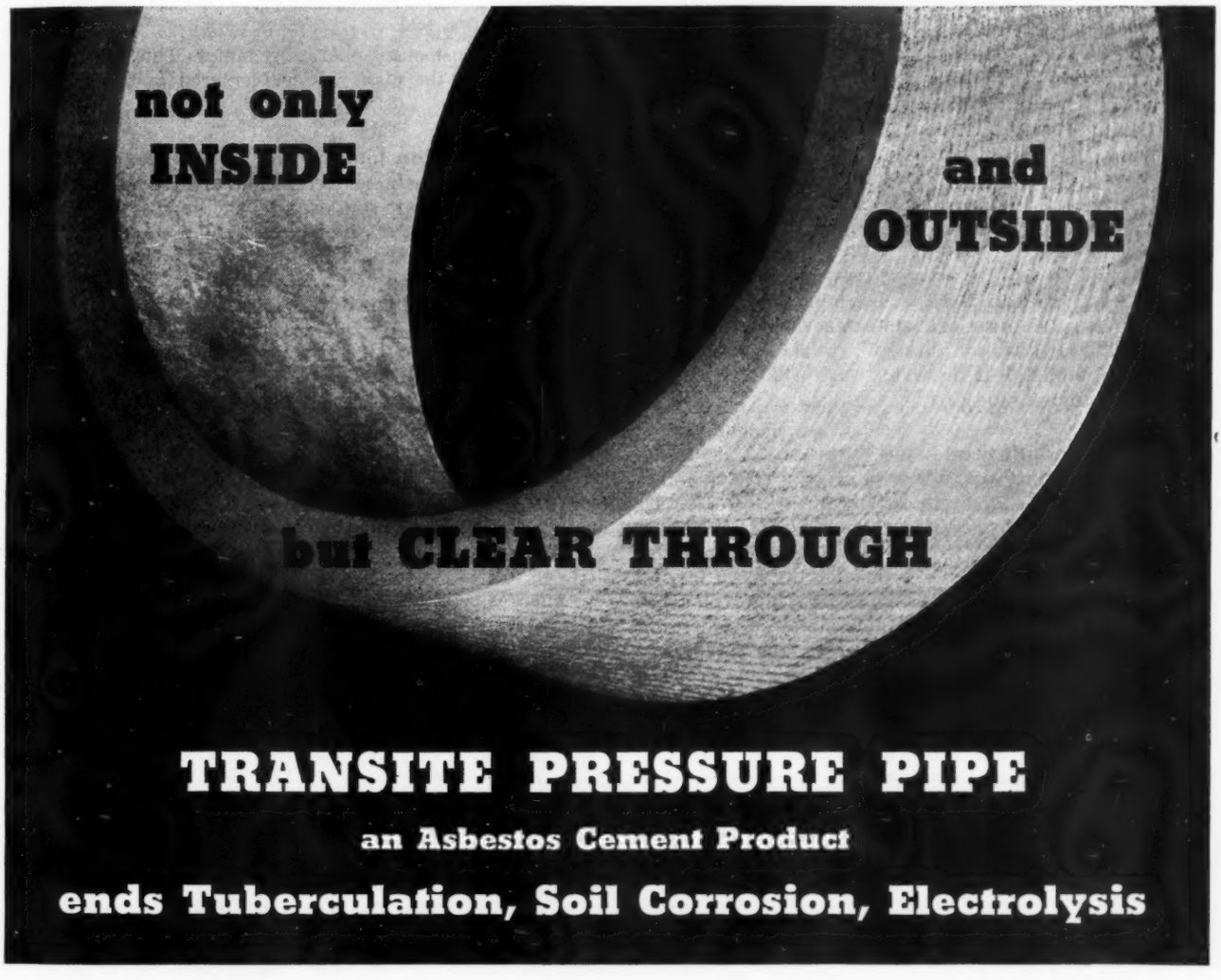
Treating Malt House Wastes

In experiments in treating malt house wastes conducted by the Bureau of Sanitary Engineering, Wisconsin State Board of Health, early in the fall of 1934, the malt house waste, which if poured untreated into a stream will extract so much free oxygen from the water that aquatic life will be endangered and nuisances created, was reduced more than 90 percent in point of its oxygen-stealing propensity.

The trickling filter system is used to reduce the pollution load, following screening of the malt waste, and the method will be recommended for malt houses in the state that are remote from large municipal sewerage systems. The preliminary screening can be effected by means of rotary screens; and if they provide this preliminary treatment of their plants, malt houses with sewerage connections can be served satisfactorily by the treatment plants of many of the larger cities.

DESIGNED TO END CORROSION TROUBLES

Built for Permanence



TRANSITE PRESSURE PIPE

an Asbestos Cement Product

ends Tuberculation, Soil Corrosion, Electrolysis

YOU dig a trench. Lay your water pipe. Cover it over. And hope that all will be well. But can you be sure? No one knows better than you that literally thousands of miles of water pipe have been destroyed or made ineffective by the three destructive agencies—tuberculation, soil corrosion and electrolysis.

And if you want to know the odds against *your* particular water line, you have available countless engineering reports and technical papers that cover the subject thoroughly . . . the reduced pressures, increased pumping and maintenance costs charged against tuberculation . . . the enormous replacement bill charged against soil corrosion and electrolysis . . .

Transite Pipe, because it is made of asbestos fibre and Portland cement, is remarkably resistant to destructive agencies—and not only inside and outside but clear through.

Transite Pipe is non-metallic; hence, tuberculation is a physical impossibility. Ordinary soil acids and salts cannot harm it. In all types of soil, under a wide variety of climatic conditions, it has been unaffected by soil corrosion. A non-conductor of electricity, it provides absolute protection against electrolysis.

Let us send you a copy of the new brochure giving complete engineering details. Mail the coupon.

Johns-Manville

JM PRODUCTS **TRANSITE PRESSURE PIPE**

JOHNS-MANVILLE, 22 East 40th Street, New York City
Please send me the new brochure on Transite Pressure Pipe.

Name_____ Title_____

Firm Name_____

Address_____

City and State_____

PW-5-35

Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

The Water Wheel

TASTE and odor are removed from water in more than 600 purification plants in America by use of powdered activated carbon. But "thus far the taste and odor from certain waste liquors from beet sugar refineries have been found to be not removable by any quantities of carbon that may be used." Some surface waters in areas suffering extreme drought have become so bad that all methods now in use fail to make them palatable.

Some weeds give odor to water, some do not. To remove taste given by chara, copper sulphate, aeration, chlorination, chlorine and ammonia were tried unsuccessfully, but filtration through activated charcoal was effective, although if the water was turbid it had to be filtered through sand first.[K5-1]

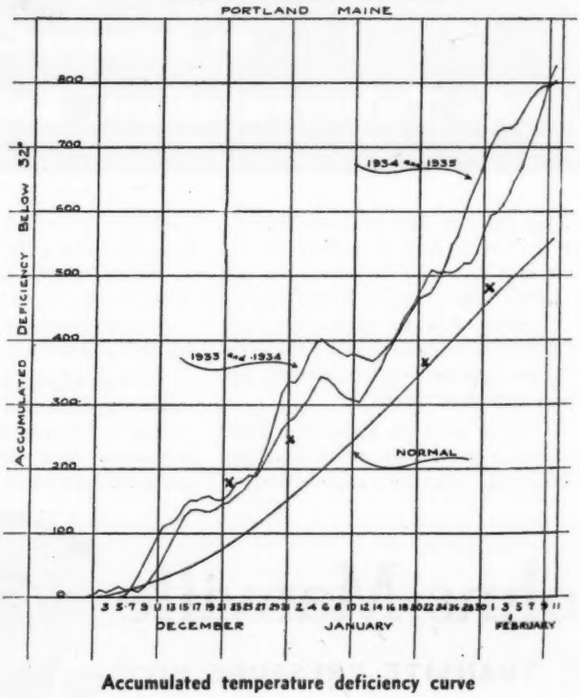
Taste and odor caused in the North York, Canada water supply by large quantities of grass, weeds and other vegetable matter brought down by spring freshets were entirely removed by aeration. A Nash-Hytor compressor driven by a 3 hp motor supplied air to sewage-type diffusion plates placed in the bottom of the alum mixing chambers. The liberal quantity of air rising to the surface carries with it the vegetable matter, which forms soap-like bubbles on the surface, which later break down and leave a brown earth-like scum which is removed daily. The operating cost is only the current required to operate the motor.[A4-15]

Lime softening and recarbonation to a residual hardness of 80 to 100 ppm will be the principal process in the new Springfield, Ill., purification plant, of 36 mgd ultimate capacity, which will cost only $22,000 per mg capacity, based on 6 filter units. (Many existing plants cost $30,000 to $40,000.) Auxiliary alum application, pre-chlorination in conjunction with ammonium sulphate, and activated carbon for odor and taste control, are provided for. To speed up chemical reactions in winter, the raw water supply will be taken from the warm water of the condenser circulating system of a nearby municipal power plant. Instead of 12 hrs. or even 6 hrs. detention in the mixing and settling basins, this time will be cut to one hour by use of specially designed tanks of 68 ft. diameter, giving downward flow mixing and upward flow sedimentation in the same tank. There are three of these tanks, which may be used in parallel; or two in parallel, while the recarbonated water is passed through the third to permit secondary precipitation; activated carbon being fed to this third tank.

The filters will be operated at twice the conventional rate of 2 gpm per sq. ft.; will have Wheeler type bottoms because of low loss of head under the washing rate of 42 in. rise per minute. The sand, 24 in. thick, will have effective size of 0.60 mm. Wash troughs are omitted. All valves will be motor operated or electrically controlled and loss-of-head and rate-of-flow gauges will be electrically operated; therefore a switch panel will replace the customary operating tables. This and all the gauges of the plant will be centered in the head house.[A4-16]

Frost penetration into the ground is believed to be related, as to depth, to the accumulated temperature deficiency (algebraic sum of daily deficiencies to date, a daily deficiency being the amount in degrees by which the mean temperature is below 32°F.) However, the relation has not been determined or its existence scientifically proved. Studies are being made in Portland, Maine, and records of the two past winters have been kept. (See diagram.) These show that by February 1st the accumulated deficiency for 1934-'35 was 125 degrees greater than the previous winter, although early in January it had been about 60 degrees lower. Few determinations of frost penetration were obtained, but systematic determination at intervals will be conducted next winter. Last winter, on Dec. 22 the frost depth was found to be 18 in. (indicated by cross in the diagram); Dec. 31 it was 24 in.; Jan. 22, 36 in., and Jan. 31, 48 in.

There is believed to be a lag of several days between temperature deficiency and frost penetration, and the latter may continue to increase after the temperature rises regularly above 32° and the cumulative curve begins to descend, accounting for freezing services in mild spring weather.[EE5-1]



Accumulated temperature deficiency curve

A MAIN LINE RAILROAD BRIDGE

IS OPERATED BY STERLING ENGINES SOMETIMES REQUIRING 32 STARTS PER DAY

Sterling High Duty Internal Combustion Engines

THE ENGINE OF REFINEMENT

12 to 565 B.H.P.—Gas or Gasoline

For lifting the span of the Penn. R. R. Lehigh Valley, Newark Bay Bridge, one Sterling Viking 11-6 cylinder 425 H.P. 1200 RPM engine and one Viking 11-8 cylinder 565 H.P. engine, each driving General Electric generators, are employed alternately; the six cylinder engine is the reserve unit.

The fuel cost is so low and the fuel supply so inexhaustible that gasoline and gas engines, with their high thermal efficiency, are being increasingly employed. Sterling engines are built for continuous duty.

STERLING ENGINE COMPANY

Home Office and Plant
1270 NIAGARA ST., BUFFALO, N. Y.

DEPT. C-5

Branch Office
900 CHRYSLER BLDG., NEW YORK, N. Y.

Let Dresser Couplings SIMPLIFY YOUR PIPE-LINE WORK!

The easiest way to join two lengths of pipe is to Dresser Couple them. Most of the work is *done before you start,* for the Dresser parts (Photo 1) are simply assembled on plain-end pipe with just one tool—a wrench (Photo 2). This standardization *in the factory* eliminates the "human equation" in the field . . . permits the use of unskilled labor . . . makes every joint perfect regardless of weather, ditch water, assembly above or below the ditch, etc.

And that's not all! The completed Dresser joints will remain *permanently, absolutely tight* for the life of the line! Hence no "allowable leakage" need be figured, and no unaccounted-for losses occur! Yet Dresser Couplings are flexible enough to absorb all ordinary pipe movements!

These proved advantages can be yours by simply specifying *Dresser Couplings*—available for all sizes and kinds of plain-end steel and cast iron pipe. *Write for further information.*

S. R. DRESSER MFG. COMPANY • BRADFORD, PA.

DRESSER COUPLINGS

Remember the *classified* READERS' SERVICE DEPT., pages 63-65.

Filter bottoms of porous plates in place of both the conventional gravel layer and its pervious means of support have been investigated by a research conducted jointly by Prof. Thomas R. Camp and the Norton Company, at the Providence, R. I., water treatment plant. It was thought that it possesses the advantages of uniform distribution of wash water and the fact that it is not displaced from position during washing, as is gravel. The head lost varies of course with the porosity of the plate. Inasmuch as nothing but filtered water is intended to pass through the plates, it might be assumed that no clogging would occur. But even with the best of filter runs there is no such thing as 100% removal of filterable matter; and some of the iron or alumina passing a filter is in such a physical state that it is subject to removal by the plates, causing clogging; and this cannot be entirely removed by passing water through. This affects lost head, but clogging automatically takes place uniformly and uniformity of distribution is not affected. Studies of rate of clogging and practical methods of cleaning are being continued by the investigators.[B5-1]

Scoring water supplies is important as a means of bringing to the atention of local authorities the hazards which threaten their supplies and the ways in which improvements may be made. It has the advantage over a bacterial examination alone that it lists all possible ways in which a supply may become polluted and possibly infected; and possibilities of future contamination are as important as existing and past contamination. It permits objective evaluation of the activities of public health work, placing the appraisal on a uniform as well as scientific basis. It aims to bring about an improvement in inferior water supplies and maintenance of a high standard of quality in all supplies.[B5-13]

Joint use of service trenches may be permissible if the alignment and grade of the water pipe is substantially the same as that of the sewer or other service, and if the water department has charge of constructing and maintaining the trench. But a water service should not be placed on a bench above a sewer, or in a crooked trench with irregular bottom; and division of responsibility for backfilling and upkeep of a trench and the paving over it is seldom satisfactory.[F4-3]

Pipe friction increase with age is often much more rapid than is indicated by the Williams-Hazen tables, which are stated to be based on supposed averages. New cast iron pipe with a coefficient of 130 when new is given by the table as having C=100 when 25 or more years old, and 80 or 90 when 35 years old. But in many districts throughout the country coefficients as low as 40, 30 and even 20 are found. In one city 55 was reached after only 8 years service. Based on data from a considerable number of plants, an average coefficient of 87 has been reached in 13 years instead of the 30 years given by the table. A committee of the New England Water Works Association is collecting data on decreasing coefficients in both unlined pipes and those with various kinds of lining, and also endeavoring to learn what factors in the quality of the water have the greatest bearing on the rate of capacity reduction.[B5-14]

Losses of heads in bends appear to vary as the square of the velocity, not the 2.25 power. Present formulas for such losses appear to apply only in cases in which approximately uniform velocity distribution exists in the approach pipe.[K5-1]

Bibliography of Recent Water Works Literature

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *t*, technical article.

B 5 — *Journal, New England Water Works Ass'n*

March

1. *t.* Experimental Study of Porous Plates for Use in Filter Bottoms for Rapid Filters. By Thomas R. Camp, pp. 1-13.
2. *t.* Gain in Head at Take-offs. By W. E. Howland, pp. 14-21.
3. Experiences with the Public Works Administration in New Hampshire, Maine and Vermont. By H. J. Lockwood, pp. 23-27.
4. Experiences with the Public Works Administration: An Engineer's Viewpoint. By A. L. Shaw, pp. 28-30.
5. Federal Aid for Water and Sewage Works in Connecticut. By W. J. Scott, pp. 31-34.
6. Experiences with the Public Works Administration in New York State. By Earl Devendorf, pp. 35-39.
7. The National Recovery Act and Public Works Administration in Massachusetts. By A. D. Weston, pp. 40-45.
8. Discussion on Public Works Administration, pp. 46-52.
9. Improvement of the Water Supply of Braintree, Mass. By R. S. Weston, pp. 53-65.
10. Status of Cross-Connection Regulations. By C. W. Mowry, pp. 66-71.
11. Activities of the New England Regional Planning Commission. By Victor M. Cutter, pp. 72-75.
12. The Water Works of Saint John, N. B. By R. W. Wigmore, pp. 76-81.
13. Sanitary Scoring of Surface Water Supplies. By A. D. Weston, pp. 82-103.
14. *t.* Pipe Line Friction Coefficients. Committee report, pp. 106-109.

E 5 — *Engineering News Record*

April 4

1. Frequency, Extent and Severity of Droughts Since 1881. By L. L. Harrold, pp. 478-479.
2. Utah Supreme Court Decisions Confuse Underground Water Law. By C. J. Ullrich, pp. 487-488.
3. *c.* Prestressed Concrete Standpipe Built in Vertical Panels. By A. P. Kuranz, pp. 488-489.

April 11

4. *t.* A Method of Calculating Efficiency of Filtration. By H. E. Hudson, Jr., pp. 528-530.

F 5 — *Water Works Engineering*

April 3

1. Regulations for Meter Accuracy. By N. N. Wolpert, pp. 325-328.
2. Million-Gallon Supply for $70,000. By J. P. Wells, pp. 329-330.

J 5 — *American City*

April

1. Meters Tell the Story (Griffin, Ga.), pp. 49-51.
2. Water Rates and Service Charges. 13 Cities, pp. 79, 81, 83.

K 5 — *Proceedings, Am. Soc. of Civil Engineers*

April

1. Water Supply Engineering. Report of Committee on Progress of Science and Art, pp. 439-447.

L 5 — *Civil Engineering*

April

1. Ten-Foot Weir and Venturi Meter Compared. By C. M. Allen and L. J. Hooper, pp. 218-220.
2. The Pitot Tube in Current Practice. By E. S. Cole, pp. 220-222.
3. The Bentzel Velocity Tube. By F. H. Falkner, pp. 222-224.

M 5 — *Canadian Engineer*

April 2

1. Convention, Canadian Section, A. W. W. A., pp. 53-100, 147.
2. Flushing of Water Mains. By C. E. Brown, pp. 57-59. By C. G. R. Armstrong, pp. 59-62.
3. Design, Construction and Operation of 40,000,000 Gallon Filtration Plant for Hamilton, Ont. By W. L. McFaul, pp. 62-66.
4. Development of Municipal Ground Water Supplies of Ontario. By W. B. Redfern, pp. 71-80.
5. Thawing Ice in Water Pipes by Electricity. By W. P. Dobson and W. B. Buchanan, pp. 83-85.
6. Laying Water Mains in Rock Formation. By F. G. Browne, pp. 87-89.
7. Operating Problems at the Peterborough Filtration Plant. By W. G. Hunt, pp. 89-90.
8. *t.* Interference of Algae with Tests for Residual Chlorine. By E. W. Johnston and W. H. Edmonds, pp. 91-96.

April 16

9. Mechanical Control in the Operation of Water Works. By A. H. R. Thomas, pp. 3-7.

P 5 — *Public Works*

April

1. Development of a Surface Water Supply. By E. L. Lium, pp 11-12.
2. Flow Test on Asbestos-Cement Pipe. By Edgar K. Wilson.
3. Treatment of Mill Scale on Water Tanks and Standpipes. By Carl A. Hechmer, pp. 34, 36.
4. Comparative Cost and Efficiency of Coagulants, p. 56.

S 5 — *Construction Methods*

April

1. Storage Tank Electrically Welded. (Sparta, N. J. See *Public Works* for October, 1933.), p. 35.

EE 5 — *Journal, Maine Water Utilities Ass'n*

April

1. Temperature Deficiency Comparison. By C. R. Moore, pp. 17-22.
2. Discounts for Prompt Payment. By F. J. Reny, pp. 23-29.
3. Effect on the Hardness, Alkalinity and pH of Sebago Water Due to Concrete Pipe. By H. B. Scales, pp. 29-33.
4. Typhoid Fever Death Rate in Maine. By J. M. Caird, pp. 34-35.

YOUR PUMP DOLLAR MUST BUY THINGS *you Cannot see*

An F-M turbine pump for handling water from deep wells.

Beneath the handsome casing of the pump you buy . . . beneath the shining brass nameplate . . . what mechanical features assure you long pump life, lowest pumping cost per gallon, most dependability?

These mechanical features that cannot be seen are often shrouded in a mist of technical language by those who cannot afford to mantain the design staffs and elaborate precision equipment necessary to produce first quality pumps. But men who *know* pumps know Fairbanks-Morse pumps are quality through and through.

They will tell you, in admiration, how the castings for F-M pumps are but slightly machined. The hard casting surface isn't gouged by filing and much "prettying up" on the grinding wheel. The hard inner surfaces and channels are made to take wear. And they'll tell you dozens of other small but very important things that Fairbanks-Morse has pioneered in mechanical design.

After all, it's the things you cannot see—the years of experience—the years of perfection in design—the thousands of successful installations—that make a great pump for any service. Whether your need is for trash, sewage, centrifugal, rotary, turbine, steam or any other type of pump, it's always well worth while to talk it over with a Fairbanks-Morse engineer. He will be glad to help you select the pump best suited to your needs. No obligation, of course. Simply address Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. 32 branches at your service throughout the United States.

Pioneer Designers and Manufacturers of POWER, PUMPING AND WEIGHING EQUIPMENT 105 Years

FAIRBANKS-MORSE
PUMPS

6308-PA95.32

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.

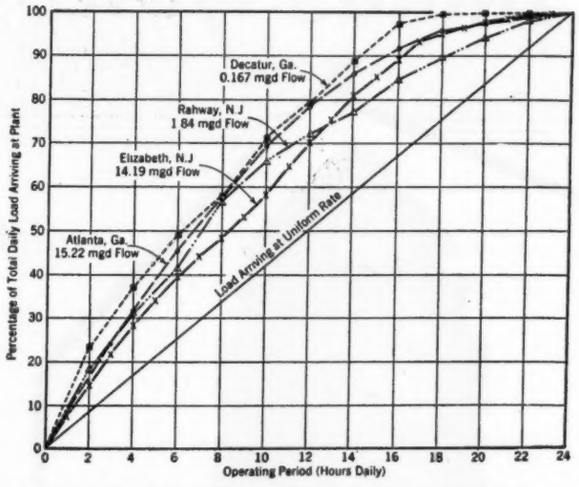
The Digestion Tank

CHEMICAL treatment in its modern form is yet in the experimental stage. The value of returned sludge, series operation of clarifiers, sludge thickening, and flocculation equipment have been proved only within the year. Simplification of process and control, with reduction in chemical consumption and operating costs, and other improvements, are certain to ensue.[L5-2]

Chemical methods, if intelligently used, are capable of providing a higher degree of treatment than has generally been attributed to them. Their greatest utility will be for intermediate treatment on part-time operation. But they also are likely to compete strongly with the best biological methods on the bases of cost, efficiency, flexibility of operation and nuisance control. Their greatest weakness is the temptation to cut operating cost by skimping on the chemical dosage rate. There is need for the development of dependable mechanical devices which will automatically adjust the chemical doses to meet the constantly changing sewage conditions. As for costs of chemicals, the trend in the future will undoubtedly be down rather than up.[L5-6]

Modern chemical treatment is superior to the older "chemical precipitation" because (among other reasons) of improvements in methods of applying and mixing the chemicals and conditioning the floc; in procedure of sedimentation, especially in small plants, and in methods of removing and handling the sludge; of possibility of sludge digestion; of simplicity of design and relatively low cost of construction.[C5-5]

Flexibility of chemical treatment is one of its most valuable assets, for the volume and strength of sewage reaching a plant varies greatly and rapidly. In a plant serving 2,200 people, the 2-hr. period of maximum load was produced by a suspended solids content of 450 ppm with a rate of flow of 0.26 mgd, giving a load of 41 lb. of suspended solids per hour; while in the 2-hr. period of minimum load, a suspended solids content of 1 ppm with a flow of 0.067 mgd gave only 0.023 lb. of suspended solids per hour—a ratio of 1:1750. In large systems the variations, of course, are not so great. In one plant serving 228,000 people, in the hour of maximum load the suspended solids content was 302 ppm and the rate of flow 19.75 mgd, giving 2,070 lb. per hour; while in the hour of minimum load, the content was 46 ppm, rate of flow 7.28 mgd, and resulting load 116 lb. per hour—a ratio of 1:18. The raw sewage during a 5-hour period in the early morning had a lower oxygen demand than would the effluent of an activated sludge plant operating at 90% efficiency on sewage of the same system during the 5-hr. period of heaviest loads. However, cumulative load curves, in which the load for the hour of maximum load and that for each successive hour of decreasing load are added indicate a surprising uniformity in the percentage of the total daily load arriving in any given number of hours. Very similar trends are found for oxygen demand, turbidity, organic nitrogen and chlorine demand. Chlorine demand in the case of the large system referred to varied in the ratio of 10:1, indicating



Rate of arrival of total daily load at various plants. Cumulative load curves based on both quantity of sewage and amount of suspended solids present.

the degree of economy possible by a variable and controlled chlorine feed. This wide load variation indicates advantages of flexible operation; prominent among them, the curtailment of the number of hours during which supplementary treatment or chemical feed is required; and concentration of operation on the heaviest sewage, which can be treated more efficiently by chemicals than can the lighter sewage.[L5-5]

Sedimentation tank designing involves so many variables that we can not be guided entirely by mathematical equations. More use should be made of models, using the sewage for which the tank is being designed. Proper baffling deserves more study, to provide that which gives the greatest value for basin capacity by avoiding eddies and getting the maximum flowing-through period. There is advantage in making baffles that can be adjusted as to depth and position and determining by test the optimum for the tank and sewage in question. At New Brunswick, N. J., a more nearly uniform flow throughout the full length of the tank and across the tank was obtained when the baffles were placed a short distance from the inlet and from the outlet and at a depth approximately one-fourth of the depth of the tank.[C5-3]

Engineers are beginning to appreciate the fact, demonstrated theoretically long since, that shallow basins, other things being equal, are more effective per unit of capacity than are deep basins. Sedimentation may be disasterously affected by wind. Basins which, if protected from wind, would be very efficient are made inefficient by agitation by wind, and housing or wind breaks are suggested.[C5-5]

Oil and grease removal is more important than is generally realized. In aeration tanks, oily sewage reduces the efficiency of aeration and may have a toxic effect on the biological organisms. Oil and grease give

tanks an unsightly appearance, and may clog trickling filter nozzles, mechanical distributors, and the surfaces of filter stone or sand. Most of the grease skimming devices and tanks so far installed have proved rather inefficient. The use of aeration to bring oil and grease to the surface, where it can collect behind baffles or be otherwise removed, seems to be the best yet devised; the amount of air required is small and 5 to 10 minutes detention is sufficient.[C5-5]

Spray drying of sludge costs $8.92 per ton of dry solids if sludge treated contains 90% water; $16.00 if it contains 94% water; $4.25 if 80% water; or about 20% less if the dried product is used for fuel. If preliminary concentration of the sludge be by filtration, a low over-all cost for filtration and spray drying together can best be obtained by running the filter rapidly and producing a cake containing from 75 to 80% of moisture; the total operating cost then being about the same as that for spray drying alone of a sludge of 90% water. The latter will, however, be most economical for communities of less than 100,000 population.[L5-1]

Pulp mill wastes in streams affect fish life chiefly by removing dissolved oxygen from the water, sulphite wastes having a much higher oxygen demand than have sulphate. Depletion of dissolved oxygen by these wastes causes fish to migrate or die of suffocation. With dilution in the stream of 1 to 200 or more, there was apparently no direct toxic effect on game fish. Ozone treatment of the wastes did little if anything to diminish the effect. Tests indicate that pulp fiber does not ordinarily accumulate in and close the gills of fish, causing suffocation; it may, however, settle to the bed of the stream and decompose, using up oxygen, or prevent the growth of aquatic vegetation and animal life which serve as fish food, and destroy spawning beds.[C5-8]

Non-corrosive sewer linings are sought by Los Angeles, primarily for lining a 32-year old outfall sewer 10 mi. long. The city laboratory has tested about 150 samples of various products, of which only two have not shown indications of breaking down under the most intensive sulphuretted hydrogen action. These are both heavy liner blocks made of special clays combined with a compound of sulphur silicate with ingredients added to promote fluidity while pouring. By laying these in close contact and running a hot iron along the joints, a continuous sulphur silicate surface is obtained. A preferred construction consists of an inner rig of hard-burned, low-absorption, segmental-cut brick with poured sulphur-silicate joints. Experiments have been conducted with sulphur silicate sprayed in a molten state over concrete surfaces. The apparatus for satisfactorily doing this has not been, but probably will be, perfected. A coating has been obtained of uniform thickness, free from pinholes, bubbles or other imperfections, but there is question as to the security of the bond or freedom from future cracking, crazing, etc. Some fear that the sulphur will be broken down by sulphur-oxidizing bacteria. Asphaltic or bituminous coatings are effective until the volatile oils escape, when the coating shrinks or crazes. Hot paraffin applied to concrete test plaques under pressure gave good results in some cases but not in others.[E5-1]

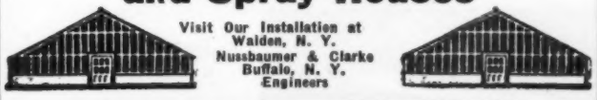
Municipal employees in the majority of cities are given little incentive to render efficient service. In Detroit, the Probst Service Rating System was used to determine to what extent salaries corresponded to the

Use PFT Equipment in Your Sewage Treatment Plant

Write for Latest Bulletins

PACIFIC FLUSH TANK COMPANY
Designers & Manufacturers of Sewerage and Sewage Treatment Equipment
4241 RAVENSWOOD AVE. CHICAGO, ILL.
EXCLUSIVELY SINCE 1893
441 LEXINGTON AVE. NEW YORK, N. Y.

GLASS COVERS
for Sludge Drying Beds and Spray Houses



Visit Our Installation at Walden, N. Y.
Nussbaumer & Clarke Buffalo, N. Y. Engineers

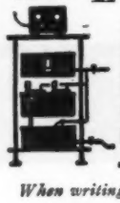
Hitchings and Company
General Offices and Factory:
ELIZABETH, N. J.

HEAVY-DUTY INCINERATION
MORSE BOULGER DESTRUCTORS
for the
INCINERATION OF MUNICIPAL WASTES
Garbage, Rubbish, Sewage Screenings and Sludge
For complete information call or write
MORSE BOULGER DESTRUCTOR COMPANY
HOME OFFICE: 202-P East 44th St., New York, N. Y.

STREET, SEWER AND WATER CASTINGS
Made of wear-resisting chilled iron in various styles, sizes and weights

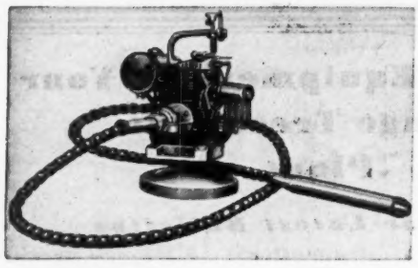
MANHOLE COVERS, WATER METER COVERS, ADJUSTABLE CURB INLETS, GUTTER CROSSING PLATES, VALVE AND LAMPHOLE COVERS
Write for Catalog and Prices
SOUTH BEND FOUNDRY CO.
All Kinds of Gray Iron Castings
SOUTH BEND, IND.

Write for Bulletin
EVERSON *Electric* **Chlorinators**



Produces Sodium Hypochlorite (NaOC1) *electrically* from ordinary salt and water. Capacity, equivalent to 12 pounds chlorine gas in 24 hours; NaOC1 stays active much longer. Ends hazard of chlorine leakage. Ideal for swimming pools, etc. Keeps water germ-free and *non-acid*. Cheapest practical method.
Everson Filter Co., 629 W. Lake St., Chicago, U. S. A.

When writing, we will appreciate your mentioning PUBLIC WORKS.



Mall 2 h.p., 3600 RPM Gasoline Engine Concrete Vibrating Machine with Automatic Clutch and 2⅜"x18' Vibrator. Can be furnished with 14 ft., 21 ft. or 28 ft. of Flexible Shafting. Also units for operation up to 6000 rpm. Attachments Available for Concrete Surfacing.

Mall

CONCRETE VIBRATORS

GASOLINE ENGINE OR ELECTRIC MOTOR UNITS

Sizes and Types for Large Mass and Small Wall Pourings

Also Ask About Our New 3 H. P. 6000 RPM Gas Engine

Write for Catalog

MALL TOOL COMPANY

7745 SOUTH CHICAGO AVE. CHICAGO, ILLINOIS

ARE YOU LOOKING FOR SPECIAL INFORMATION?

Turn to the Readers' Service Department —pp. 63 to 65— where you will find descriptions of many helpful booklets which are free on request.

Association

Once again the red and yellow glare of molten metal reflects against the Pittsburgh sky. Experienced travellers recognize this sky coloring as typically Pittsburgh, just as they associate Pittsburgh and this fine hotel as the best address and the largest hotel in Pennsylvania.

RATES FROM $3.50 SINGLE • $5.00 DOUBLE

YOU WILL ENJOY YOUR STAY HERE

HOTEL WILLIAM PENN

PITTSBURGH · PENNSYLVANIA

GERALD P O'NEILL, General Manager

When writing, we will appreciate your mentioning PUBLIC WORKS.

service value rendered by the individual employees of the water department. This "shows that there is no relationship between rate of pay and service value, except that it does indicate a distinct tendency to fix the salary rate in an inverse order to service value." Mr. Smith and others believe similar conditions are quite general throughout the country. In spite of this, many municipal employees do their best because of correct work habits due to previous training, desire to excel or the satisfaction of doing a job right. The seniority rule is better than political reasons for promotion, but much better is a merit system that is workable and reasonably accurate. The city manager of Cincinnati finds the Probst system working well in that city.[A2-3]

Bibliography of Recent Sewerage Literature

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *t*, technical article.

C 5 — *Sewage Works Journal*

March

1. Research in Sewage Chemistry, Sewage Treatment and Stream Pollution: Review of 1934 Literature. By Wellington Donaldson, Linn H. Enslow, L. M. Fisher, Samuel A. Greeley, W. S. Mahlie, Willem Rudolfs and Earle B. Phelps, pp. 149-181.
2. *t.* Measurement of Intensity and Concentration of Odors Associated with Sewage Treatment Processes. By G. M. Fair and E. W. Moore, pp. 182-199.
3. *t.* Notes on Sedimentation. By L. V. Carpenter and H. W. Speiden, pp. 200-213.
4. *t.* Biochemical Changes in the Formation of Activated Sludge. By H. Heukelekian, pp. 214-221.
5. Sewage Treatment Problems and Trends. By C. G. Hyde, pp. 222-232.
6. The Rating of Sewage Treatment Works: Report of Rating Committee, New York State Sewage Works Ass'n, pp. 233-250.
7. *t.* Measures of Natural Oxidation in Polluted Streams. By H. W. Streeter, pp. 251-279.
8. Effects of Pulp and Paper Mill Wastes on Fish. By A. E. Cole, pp. 280-302.

D 5 — *The Surveyor*

March 15

1. Incineration of Sewage Solids. By A. E. Stilson, pp. 371-372.
2. Settlement of Sewage, p. 375.

March 22

3. Some Important Considerations Affecting the Design of Sewage Treatment Works. By Granville Berry, pp. 399-400.
4. Sewage Effluent Standards, Thames Conservancy Act, p. 410.

March 29

5. Rochester, Chatham and Gillingham Sewerage and Sewage Disposal Works. By R. L. Honey, pp. 435-436.

April 5

6. Greater London Drainage: The Centralization Project, pp. 455-456.
7. Criticism of the Albuminoid Ammonia Determination. By W. Watson, pp. 469-471.

E 5 — *Engineering News-Record*

March 28

1. Sewer-Lining Materials Tested for Corrosion Resistance. By H. G. Smith, pp. 444-445.

H 5 — *Municipal Sanitation*

April

1. $250,000 Plant Built with Federal Aid. By Francis S. Friel, pp. 100-103.
2. My Ideal Incinerator. By A. Westwater, pp. 104-106, 117.

J 5 — *American City*

April

1. Making the Most of Sewage Plant Visitors. By R. S. Lamphear, pp. 63-64.

L 5 — *Civil Engineering*

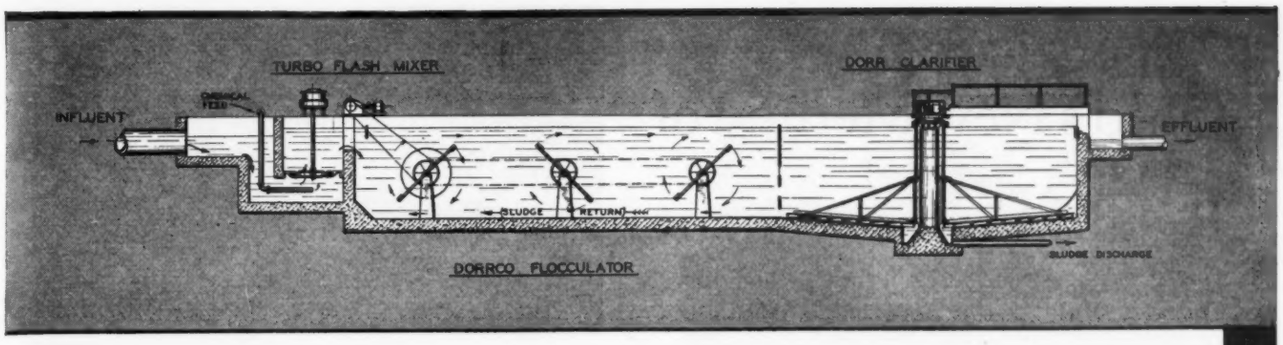
April

1. Spray Drying of Sewage Sludge. By C. L. Riley, p. 231.
2. Chemical Precipitation Processes. By L. H. Enslow, pp. 235-239.
3. Some Experiences at Birmingham, Ala. By H. H. Hendon, pp. 239-241.
4. Operation and Improvement of Dearborn Plant. By Mark B. Owen, pp. 241-243.
5. Operation of Chemical Treatment Plants. By E. T. Killam, pp. 243-245.
6. Outlook for Chemical Sewage Treatment. By W. Donaldson, p. 245.
7. Role of the Sanitary Engineer in Industry. By A. C. Decker, pp. 246-248.

P 5 — *Public Works*

April

1. Sewer Construction in Oklahoma City under Federal Relief. By Virden A. Rittgers, pp. 20-22.
2. Chemical Treatment of Sewage at Dallas. By E. W. Steel and P. J. A. Zeller, p. 23.
3. Sewage Treatment Methods for New York, p. 27.
4. Solving a Problem in Street Drainage. By Fred X. Conrad, pp. 30, 32.
5. Treatment of Commercial Wastes in Connecticut, p. 49.



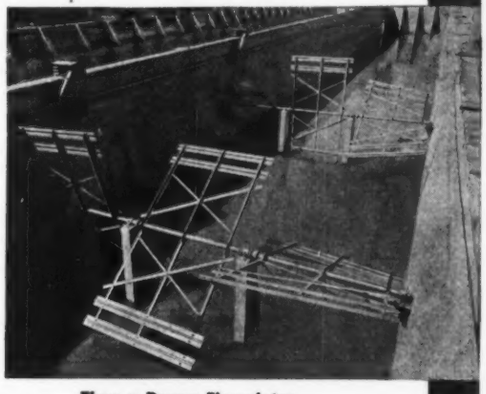
COMPLETE WATER PRE-TREATMENT

• • • IN A *Single* UNIT

THREE steps—not one or two—are needed to prepare water properly for a filtration plant. Now for the first time, these three steps are offered in a single compact unit, for installation directly ahead of the filters.

First, a Dorrco Turbo Flash Mixer

MIXING comes first, in a Dorrco Turbo Flash Mixer with chemicals introduced directly under the high speed impeller. Result, complete two-directional diffusion of the chemical throughout the incoming raw water in a fraction of the usual time.



Then a Dorrco Flocculator

FLOCCULATION is the next step, in a Dorrco Flocculator. As a result chemical consumption is reduced 10-40 per cent, filter wash water is cut 20-30 per cent and the coarse, dense flocs formed settle and filter more rapidly. The return of sludge, an exclusive Dorr feature, is largely responsible.

CLARIFICATION is the last step, in a Dorr Clarifier installed directly in the end of the flocculation basin. Solids are removed continuously at maximum density and a uniformly clear water overflows at all times to the filters.

Finally a Dorr Clarifier

DORRCO

Let our engineers show you how an installation like this is a self-liquidating investment that pays for itself out of savings.

THE DORR COMPANY INC.

CHICAGO TORONTO • **ENGINEERS • 247 Park Ave., New York** • DENVER LOS ANGELES

DORR TECHNICAL SERVICES AND EQUIPMENT ARE AVAILABLE FROM THE FOLLOWING COMPANIES:

HOLLAND: Dorr-Oliver N. V. The Hague
FRANCE: Soc. Dorr-Oliver, Paris
ENGLAND: Dorr-Oliver Company Ltd., London
AUSTRALIA: Crossle & Duffy Pty. Ltd., Melbourne
SOUTH AFRICA: Edward L. Bateman Pty. Ltd., Johannesburg
GERMANY: Dorr Gesellschaft, m. b. H. Berlin
JAPAN: Andrews & George Co. Inc., Tokio

Remember the *classified* READERS' SERVICE DEPT., pages 63-65.

Ohio's New Method of Road Mix Treatment

By G. M. Anderson
Chief Engineer of Maintenance, Ohio Dept. of Highways

A TYPE of surface treatment or road mix has been developed in Ohio during the past two years which has appealed to both engineers and traveling public for rapidity of accomplishment and absence of some of the disagreeable features of this type of work. Most of the roads so treated had already received an original treatment but had become rough from usage and required sealing and smoothing and the addition of a strengthening wearing course.

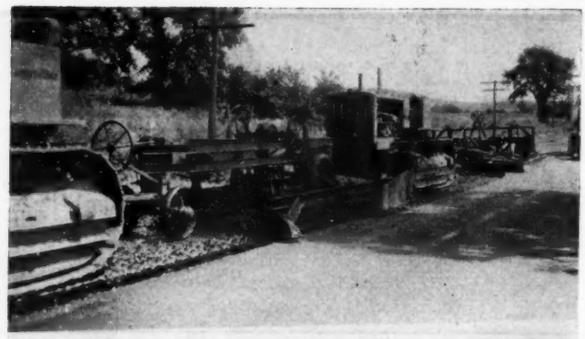
Former methods of applying this type of surface or road mix developed the following objectionable features: With the equipment available, it was necessary to employ a bituminous cement of comparatively low viscosity which would not set up quickly, since this equipment necessitated two and sometimes four or more trips over the entire surface, to the end of which the binder must be thoroughly workable.

Low viscosity necessitated traffic detours to prevent damage to both cars and pavement caused by the wheels picking up the bituminous material and rutting the finished surface. Also such bituminous material results in eventual bleeding and slipperiness; and low-viscosity cement gives a coating to the aggregate too thin to provide sufficient adhesiveness.

The equipment available for spreading the aggregate uniformly on the road surface and for mixing it was inadequate. In this type it is highly important that the aggregate be spread to a uniform depth over every square unit of surface, to insure uniformity of mix and of texture in the finished surface, and that the equipment be adequate to thoroughly mix bituminous material and aggregate.

Speed of construction was curtailed by the above, since distributor operation generally had to be stopped an hour or two before the end of the working period so that surface finishing could be completed before nightfall; which in turn of course increased construction costs for labor, demurrage and detour maintenance, and to the motorist for use of detours.

After experiencing these objections for several years we decided to work toward developing a mixed-in-place bituminous surface that would (1) convenience traffic by treating one half the road at a time; (2) allow use of a bituminous cement that would (*a*) be liquid enough for mixing but cure within approximately an hour thereafter, permitting rolling to follow closely behind the mixing; (*b*) immediately after mixing attain a consistency that would resist picking up by wheels even if rapidly driven, and no more than paint the tires slightly with slow driving; (*c*) have a low penetration or high viscosity providing strength and stability in the mat through the deposit of a thick film on the aggregate particles, at the same time permitting sufficient flexibility;



Top—Road-mix equipment in tandem. Finisher in rear. Note (at extreme right) truck passing along the work.
Second—Spreading aggregate. Note uniformity of width and surface. This spreader has spread as much as 1,100 tons in one day.
Third—Applying asphalt powder on oil-coated aggregate ahead of mixer.
Bottom—Road oiled aggregate and ashphalt powder. S. R. No. 41 in Highland County.

(3) allow for the use of an aggregate of proper grading to provide density in the mat and produce a non-skid surface; (4) allow for the use of equipment that would (*a*) permit mixing, spreading and finishing to desired cross section and contour in *one operation* on one half the road at a time; (*b*) spread the aggregate uniformly on the road surface prior to application of bituminous material; (*c*) be speedy enough to follow immediately behind the distributor operation and mix and finish as fast as the bitumen is distributed; (*d*) provide enough trucks and distributors to keep the operation in constant progress, limiting the rate of progress only by the speed

of the tractor pulling the mixing equipment (six miles of completed surface on one side in one day is a fair average); and (*e*) permit of mixing the aggregate with a minimum of bituminous material, avoiding any possibility of an excess and consequent tendency to bleeding.

The new method was demonstrated in resurfacing S. R. No. 50 in Ross County, Ohio, a main east-west route where detouring is exceedingly difficult. This project was 6.8 miles long and 20 feet wide—an old traffic-bound gravel road which had become thoroughly stabilized and then been surface treated. Beginning Monday morning, by Monday night the 6.8 miles had been resurfaced on one side and was carrying traffic without picking up; by Tuesday night the whole road had been resurfaced and was carrying traffic, and on Wednesday the crews left for another job. Traffic had at no time been interrupted, 46,000 gals. of asphalt cut-back and 1,889 tons of crushed aggregate were used, hauled by 25 trucks from a local plant with an average haul of 7 miles. The treatment measures slightly less than one inch compacted. The cost was $926 per mile, including all labor, aggregate, asphalt and their application, and cost of moving the equipment to and from the job. Equipment depreciation, repairs, insurance and interest are not included but would total less than $100 a mile.

Adopting the same procedure, we have built wedge courses on widened macadam followed by retread surfaces. Also we have experimented in the blending of asphalt powder and flux road oils to produce oil mats in which the amalgamation of the two materials approaches the consistency of asphaltic cement. The road oil we use is a liquid asphaltic oil of low viscosity and slow curing, which keeps the road surface sloppy for two or three weeks after application. In the experiment referred to we first spread the aggregate (containing 10 to 15% dust), applied regular road oil to this, mixed the two together, applied an asphalt powder to the mixture, then with the mixing and finishing equipment mixed the asphalt powder with the coated aggregate and finished immediately. The entire operation was continuous, with no turning back over the work. Traffic was maintained on the side not being treated, and was turned onto the other side without inconvenience as soon as it had been completed. The result of this experiment was excellent and we plan experimenting with blending low and high viscosity liquid bituminous materials with a view to eradicating sloppy roads.

The operation of this new process has been made possible by improved equipment designed and built in our division garage. In general terms, it is a combination of two cooperating units—a mixing and distributing unit and a strike-off or finishing unit. The former consists of a multiple-blade maintainer, in the rear blades of which has been built a system of control gates for distributing the material from one side to the other or to the center of the strike-off unit, as desired. The finishing unit consists of two 20 ft. slidable forms spaced 10 ft. apart, to the center of which has been mounted a strike-off blade, adjustable at either end. In joining these two units, the two forward ends of the forms of the strike-off unit are joined to the mixing and distributing unit by means of pins operating in slotted holes in such manner that vertical movements of the maintainer (caused by irregularities of the old road surface) are not transmitted to the strike-off unit. The strike-off blade, being joined to the center of the forms, permits their front or rear ends to rise or fall in sliding over the irregular surface with minimum distortion of the cross-section as defined by the strike-off blade and forms.

JAEGER *Adjustable* SPREADER

Smoothly Spreads Stone, Macadam and Bituminous—1" to 7" Thickness, 8 to 11 Ft. Widths.

Lays low costroads, faster, smoother and with real savings.

JAEGER BITUMINOUS PAVER

power-driven, adjustable 9 to 15 ft., does precision job without forms. Write for details.

THE JAEGER MACHINE CO.
400 Dublin Ave., Columbus, Ohio

QUINN PIPE FORMS

HAND or WET PROCESS

Make concrete pipe on the job with *Quinn Pipe Forms*. Gives employment AT HOME where it is needed. Quinn Pipe Forms can be handled by less experienced labor and produce uniform concrete pipe of highest quality.

HEAVY DUTY
CONCRETE PIPE FORMS

Built to give more years of service—sizes for any diameter pipe from 12 to 84 inches—tongue and groove or bell end pipe—any length. Backed by years of service in the hands of contractors, municipal departments and pipe manufacturers.

NEW
MEDIUM DUTY
CONCRETE PIPE FORMS

Meet the demand for low cost equipment that produces a uniform quality of pipe in smaller amounts. Complete in every way. Stands up on any job. Same sizes as "Heavy Duty," from 12 to 84 inches—any length.

WRITE TODAY

Get complete information on prices and Special Construction features of Quinn Pipe Forms. Give us size of job for estimate on your pipe form needs.
Also manufacturers of concrete pipe machines for making pipe by machine process

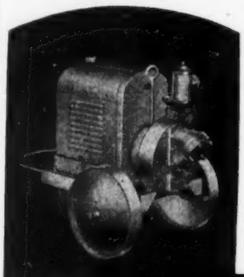
QUINN WIRE & IRON WORKS
1621 TWELFTH ST. BOONE, IOWA

When writing, we will appreciate your mentioning PUBLIC WORKS.

GET THIS FREE PUMP BOOK

JUST OFF THE PRESS

A combined catalog and handbook of engineering data of great value to every Engineer, Contractor or anyone interested in pumping problems.



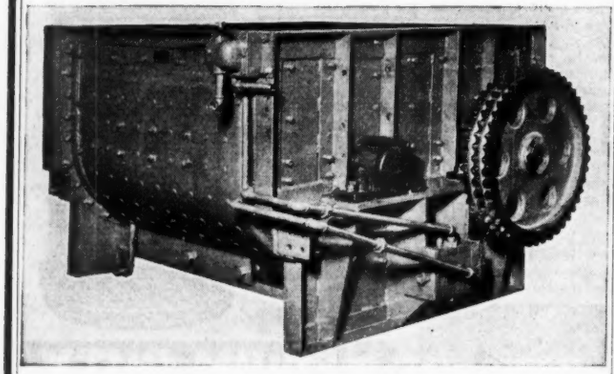
A PUMP FOR EVERY PURPOSE

Regardless of your requirements — there's a Sterling Quality Pump for every job—from the smallest 2" pump to the husky 8" pump designed for big volume work.

Our Engineering Department will gladly offer helpful suggestions without obligation.

Sterling
MACHINERY CORPORATION
411-13 Southwest Blvd. Kansas City, Mo.

STEAM JACKETED
STEAM OPERATED ASPHALT MIXERS
For Bituminous Mixtures of All Kinds



COMPACT DESIGN
WELDED STEEL CONSTRUCTION
ANTI FRICTION BEARINGS
ADJUSTABLE & REMOVABLE BLADE TIPS

Send for Bulletin P-234

HETHERINGTON & BERNER, Inc.
INDIANAPOLIS, IND.

Builders Of Asphalt Paving Machinery For 30 Years

When writing, we will appreciate your mentioning PUBLIC WORKS.

A considerable quantity of mixed material is carried in a hopper-like arrangement located just in front of the strike-off blade to take care of depressions in the old road surface and eliminate excess crown.

The operator stands on a platform directly in the rear of the strike-off blade within ready access to all the controls, both of the mixing unit and the strike-off unit, and is in position to easily observe the required distribution of the mixed material as he looks ahead. The 20 ft. forms operating as two 20 ft. straight edges provide for an exceptionally smooth surface and also leave a straight, uniform, square edge at either side automatically. The whole arrangement permits of straight line production on one-half width without turning of equipment, allowing rolling to follow closely behind the mixing operation.

We use both tars and asphalts in our work. While they do not operate in exactly the same way, proper selection of the grade used will give similar results.

By employing this method of doing the work delay is at a minimum and by placing aggregate on the surface only when weather conditions are suitable, there is never any half completed work which is disagreeable for passage. It is felt that the method of completing all operations on one half width before doing any work on the other half is essentially sound. It is also felt that equipment should be mobilized to the extent necessary to provide for completion of all operations in one passage of the equipment rather than have the many turnings as is generally the practice. Not only is traffic better taken care of, but there is an actual reduction of cost due to the development of a high morale on the work and the enthusiastic cooperation of all labor and equipment operators to see how fast and how good they can accomplish the desired results. Two complete shifts of men were employed each day on our work and as one observer commented "neither a shovel handle nor a truck steering wheel had time to get cold between shifts."

This article was abstracted from a paper presented before the National Crushed Stone Ass'n.

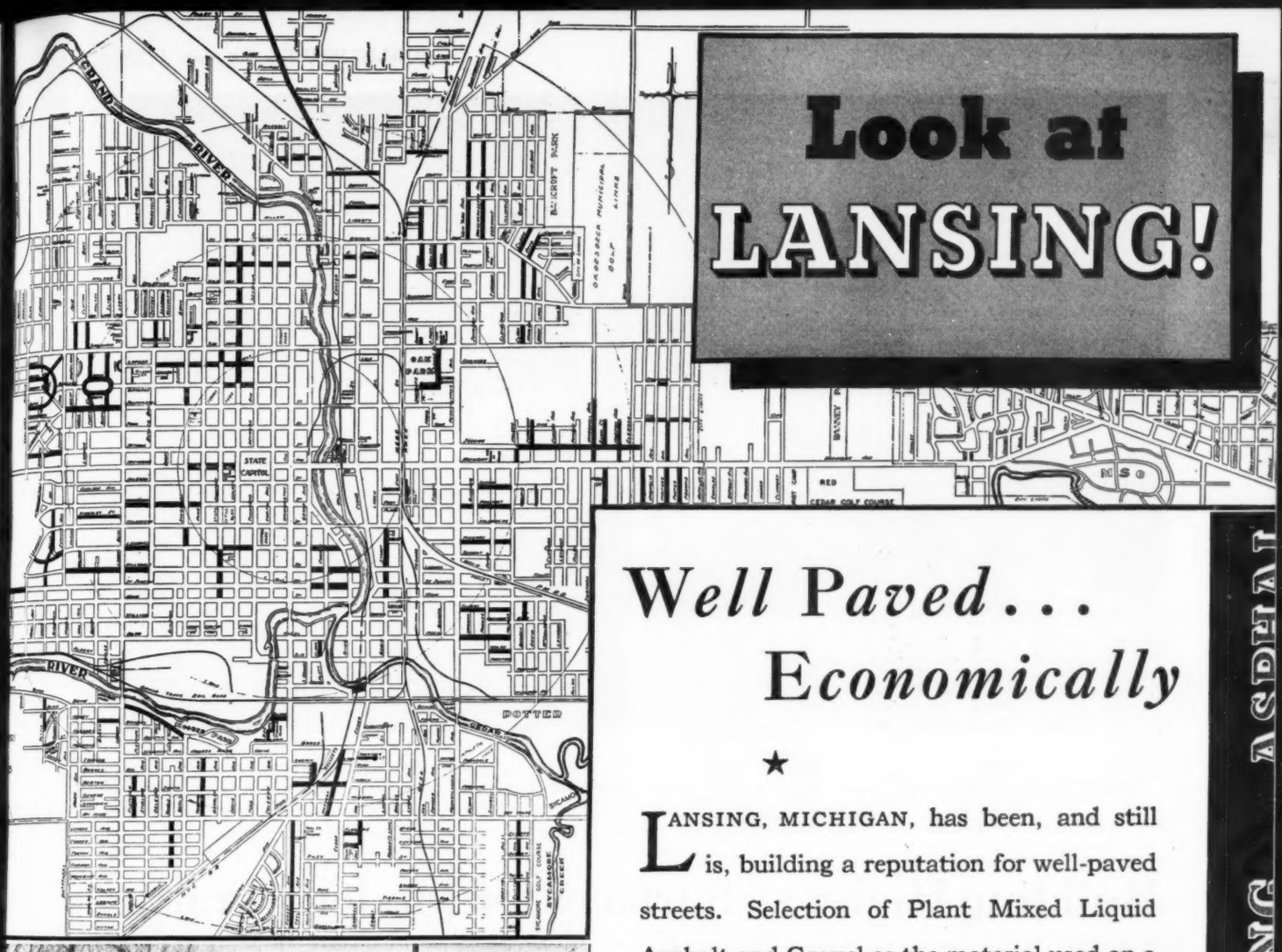
Flake Calcium Chloride Dissolves in Cement Mixer

Tests conducted by the Highway Department of the District of Columbia show that complete dissolution of the calcium chloride will take place within the mixing time and that entirely satisfactory results will be obtained by placing the dry flake calcium chloride directly in with the materials in the skip, as well as if the solution of calcium chloride were added in with the mixing water or directly into the drum of the mixer.

This method is of particular importance for use on small projects where it is not practicable to require equipment designed to mechanically control the incorporation of the specified amount of calcium chloride.

In the laboratory tests conducted to determine the completeness of solution, the mixing water containing calcium chloride was filtered from the concrete after the completion of one minute of mixing in a 2½ cu. ft. mixer. In all instances the calcium chloride concentration of the filtered solution was determined. and the results obtained definitely revealed that complete solution of the dry flake chloride had resulted.

Tests were also conducted on numerous sets of control beams (6x6x30 inches) made under comparative field conditions, in which calcium chloride was introduced into the mix in the dry flake as well as in the solution form. It was evident from the beam tests that both methods of introducing calcium chloride provided equally high strengths.



Look at LANSING!

Well Paved . . . Economically

★

LANSING, MICHIGAN, has been, and still is, building a reputation for well-paved streets. Selection of Plant Mixed Liquid Asphalt and Gravel as the material used on a major portion of this work speaks highly for the diligent economy of Lansing officials. This work has been carried forward for the past four years.

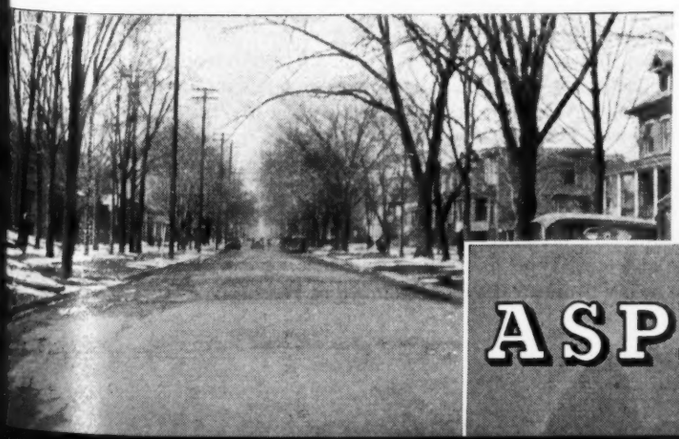
Blacked-in streets on the map above show the places in which Standard Asphalt Road Oil has been used since 1930—275,000 yards.

Stanolind Asphalt Products provide correct materials for every type of traffic demand. You'll find it pays to call in the Standard Oil representative on every paving job.

STANDARD OIL COMPANY (*Indiana*)
910 South Michigan Avenue, Chicago, Ill.

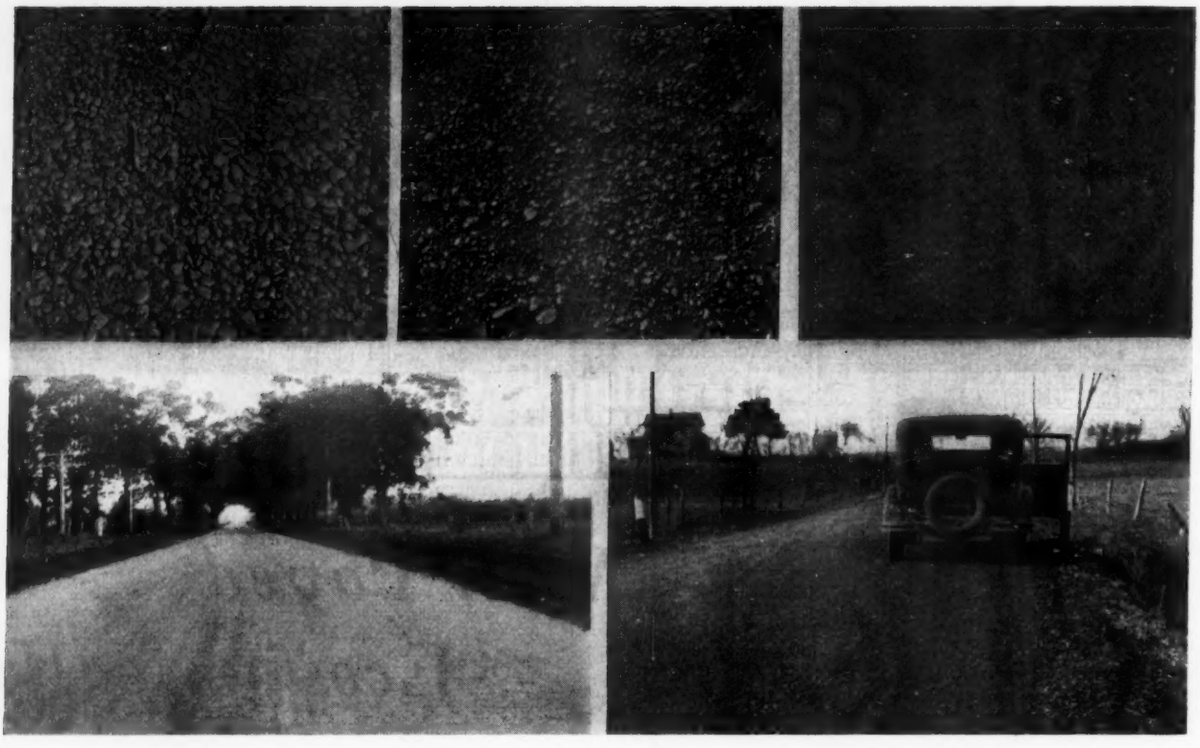
Copr. 1935, Standard Oil Co.

Samuel C. Jacka, City Engineer of Lansing, is supervising the program that is making his city one of the best paved in the State of Michigan. A view of the State Capitol is shown above.



ASPHALT FOR PAVING

ASPHALT *for every Purpos*



A tightly sealed tar gravel mulch. Loose unsealed gravel mulch.

Above: Unsealed gravel mulch—almost certain to ravel. Center: Poorly graded large size cover. Right: Well sealed tar macadam.

Building Highway Surfaces for Modern Traffic

By Geo. E. Martin

Consulting Engineer, General Tarvia Dept., The Barrett Co.

THE average speed of automobiles has increased by ten to twenty miles per hour in the past two or three years. Tires have been increased in size and the air pressure in them has been lowered, thus increasing the area of contact with the road surface. Trucks, as well as automobiles, have increased their speed and gone from solid to pneumatic tires. Roughened tire treads, to reduce skidding, have been perfected and widely marketed. All of these factors have increased the tearing action on the road surfaces and have reduced the consolidating or compacting action.

What is the answer? One answer would be to build only high type, expensive surfaces which do resist these tearing actions. That is not possible, in many instances, for economic reasons alone. Also, what is to be done with the many miles of such high-class roads and streets now in need of re-surfacing? Must they be thrown away and a new road built? The other answer is to modify the low-cost bituminous surfaces such as Re-Tread, mixed-in-place and surface treatments so that they will more efficiently meet the demands upon them. Fortunately such modifications are neither difficult nor expensive.

One difficulty has been the use of uniform size covering material and too large cover material on seal coat work. The reason advanced for the use of large-sized cover aggregate has been the necessity of such material to produce a skid-safe road surface. Just because an open surface with large, knobby aggregate exposed looks like it ought to be more nearly non-skid is no guarantee that it is. As a matter of fact, recent tests have shown that the most nearly non-skid bituminous surface is that with a fine surface texture, like sandpaper. The actual size of aggregate used for cover will vary with the type of bituminous material, the locality where the work is being done and the type of aggregate used. Generally speaking, for cold surface treatment tars, the covering aggregate should be free from dust and be well graded from a No. 8 sieve to a ⅜" square opening sieve. For hot surface treatment tars, it should be free from dust and be well graded from a No. 8 sieve to a ¾" square opening sieve.

Another source of difficulty has been the use of too much cover. Too little cover usually does no great harm and the remedy is obvious. Not so with too much cover. Once distributed on the road it is difficult to remove. It is generally felt that traffic will remove the excess. It does, but some bituminous material is removed with the excess cover and the loose cover on the surface acts as an abrasive under traffic and grinds away the cover which was held tightly. Even expensive rigid pavements are harmed by loose abrasive material left on the surface under traffic. In determining the amount of cover to use, consideration must be given to the type of bituminous material, the surface being treated, and the size and type of aggregate used. A porous open surface will naturally absorb more of the surface treat-

ment of bitumen and, of a given quantity applied, less is available to hold the cover. Neglect of this factor has caused many apparently mysterious surface treatment failures. Less of the smaller sized cover will be required because it has more surface area to be covered per pound of aggregate. Less of the porous and absorbent aggregate will be required in comparison with those aggregate having a hard, dense surface. As a rough guide, about ten pounds of normal stone cover will be necessary for each 0.1 gallon of tar used as a surface treatment on a tight surface. A minimum of 0.1 gallon per square yard will be held as a paint coat on the old surface and will not be available for holding covering material.

Dragging Surface Treatments

Indiscriminate dragging of bituminous surface treatments has done more harm than good. The chief object in dragging, with a sled drag or similar machine, is to produce an even, easy riding surface. If the surface is already a good riding one, and the treatment is only to replace the material worn away by traffic, then dragging is unnecessary except to distribute the covering material uniformly. For this purpose, a broom drag, a section of woven wire guard rail, or similar apparatus is much more satisfactory than an implement, like the sled drag, which mixes the entire depth of the cover.

If the road is rough, it should be smoothed by the use of a leveling course of bituminous material and aggregate, mixed-in-place on the road with a drag or similar machine. This dragged leveling course should then be sealed with liquid bituminous material and covered with small sized aggregate. This final seal coat should not be disturbed by dragging.

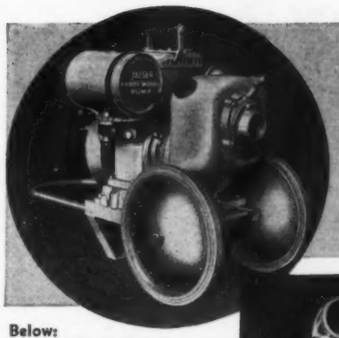
Mixed-in-place gravel mulch treatments should have a final seal or fog coat as a part of the building operation. The seal will vary from one-eighth to one-third gallon per square yard, depending upon the character of the original gravel mulch. An open surface will require more tar than a closed one. The mix itself should be rather lean and the top thoroughly sealed. Here again a small sized cover should be used and the seal should not be torn and broken by dragging.

The single seal on Re-Tread or mixed-in-place surfaces, using crushed aggregate, has often penetrated into the mixed course, due to inadequate choking of the surface. To correct this tendency it is now considered better practice to use an application of about one-third of a gallon of hot tar per square yard on top of the choke stone, covered lightly, swept and rolled, and followed by the seal coat of one-quarter gallon of hot tar per square yard covered with small sized cover. This final seal should not be dragged except with a brush or broom drag to distribute the cover material uniformly. New York, for example, uses their No 1A stone ranging in size from ⅛" square screen to ¼" square screen for both choke and cover stone, with very satisfactory results.

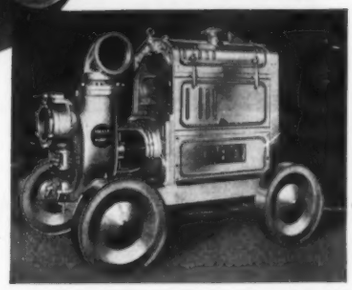
Essentials in Construction

1. An adequate and properly drained sub-grade and foundation to support the expected loads.
2. The proper proportions of bituminous materials and aggregate in the mixed portion of the construction.
3. The final operation to be the application of a bituminous seal coat, with the correct amount of small sized, dust-free, covering aggregate. This seal coat not to be disturbed by dragging and mixing with the covering material.

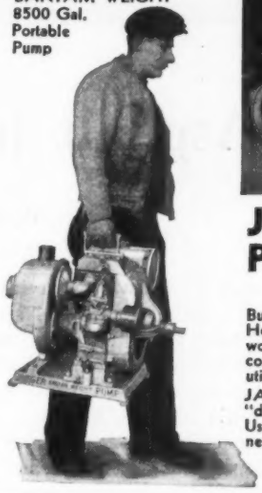
With these few precautions, low-cost bituminous surfaces can be made much more efficient at no appreciable extra cost.



$115.00
$10 Extra for Rubber Tires
buys this
8500 Gal.
"Handy Model"



Below:
"BANTAM WEIGHT"
8500 Gal.
Portable
Pump

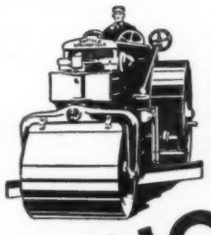


JAEGER "SURE PRIME" PUMPS
(10,000 TO 135,000 GALLONS)

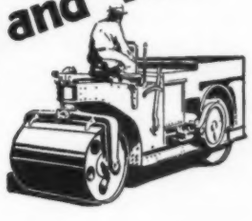
Built in 2", 3", 4", 6" and 8" sizes, Jaeger Heavy Duty Self-Priming Centrifugals are world's largest selling pump of their type for construction jobs, industrial work, public utility and municipal maintenance, etc.

JAEGER WELL POINT SYSTEMS provide "dry job" conditions at lowest known cost. Used on small jobs and biggest. Send for new CATALOG P-35.

THE JAEGER MACHINE CO.
400 Dublin Ave., Columbus, Ohio



BUFFALO-SPRINGFIELD
Three Wheel and Tandem



Buffalo-Springfield's complete range of models in both three-wheel and tandem rollers permits the purchaser to select the proper machines for his work.

Full details will be furnished on request.

THE BUFFALO-SPRINGFIELD ROLLER CO.
SPRINGFIELD, OHIO

When writing, we will appreciate your mentioning PUBLIC WORKS.

Lincolnite roads in Memorial Park Cemetery, Sylvania, O.

Powdered Asphalt in Oil Mat Construction

By H. C. Offutt

A FEW years ago aggregates containing a large percentage of material passing the No. 4 sieve were considered unsuitable for bituminous road construction because the viscous binders then in use could not be used with them except in hot-mix operations. The development of liquid asphaltic binders, however, allowed mixing and laying these cheaper aggregates at normal temperatures with much less costly machinery and personnel; and revoluntionized asphalt paving practice.

Some highway engineers consider that asphaltic oil does not retain its cementing and waterproofing properties for a sufficient length of time to be economical; being a fluid, it does not coat the aggregate with a thick film of material, and not enough asphalt is present to give long life and weather resistance—in two or three years it oxidizes to the point of beginning to disintegrate.

It is generally recognized that asphalt gives the best results when used as the cementing medium for bonding aggregates together. To a considerable extent, viscosity is the measure of a bituminous material's cementing strength and waterproofing capacity; and the more asphalt a bituminous material contains, the more viscous it is. Film thickness is largely controlled by viscosity; and as viscosity increases, the characteristics of the binder approach more closely to those of asphalt cement. Therefore the binder should have as high an initial viscosity as is practical for the method of construction.

In a series of laboratory experiments the Lincoln Oil Refining Co. found that asphaltic oil would blend and amalgamate with finely powdered asphalt to produce an asphalt cement. An asphaltic oil of 300 viscosity at 122° F (Furol) blended with 15% of such asphalt produced an asphaltic oil of about 1300 viscosity at 122° F; blended with 25% of powdered asphalt produced a binder too viscous to be measured by the viscosimeter and too soft to be measured by the penetrometer, but had a float test of about 100 at 122° F; blending with 35% of powdered asphalt produced a cement of about 250 penetration, and with 50% produced an asphalt cement of about 30 penetration.

The problem of adding more asphalt to the oil in the mat, and still have all particles of the aggregate uniformly and satisfactorily coated with a film of binder, was solved by first priming the aggregate with the asphaltic oil and producing a uniform film of the bituminous material on each particle of aggregate. The films of asphaltic oil were then thickened and the quality and quantity of the asphalt in films on the aggregate was increased by adding the powdered asphalt to the oil-coated mixture. The union of the two in films around the aggregate produces thicker and more adhesive coatings which are more viscous and less fluid. The bitumen in these films adheres more tightly to the aggregate, does not become fluid in hot weather, forms a much better waterproofing cover and binds the aggregate more firmly together.

Such a mat, properly constructed on a good base, will not have to receive much patching during its first years of service, and it will not be necessary to surface-treat it for at least three or four years. It should never have to be reconditioned; and when no longer serviceable as a wearing course can be used as a base for future improvements. It will have stability and durability two or three times that of the ordinary oil mat, the stability machine used in State highway laboratories measuring the stability of the latter at about 200 pounds per square inch and that of the oil-powder mixture at 600 to 800 pounds.

Powdered asphalt was first used in oil mat construction (road-mix process) in the fall of 1930 in southern Indiana. The work was very satisfactory and led to its use in about 50 miles of mat construction in 1931 and about 300 miles in 1932. All these mats were made by the road-mix process. Other mats were constructed in 1931 and succeeding years, in the states of Illinois, Indiana, Ohio and Missouri, most of which are still giving very good service.

The oil-powder type of bituminous mat is now being constructed in Minnesota, Kansas, Nebraska, Iowa, Michigan, West Virginia, North Dakota and South Dakota also. In most places the bituminous mat is made by the road-mix process; in some by the traveling plant-mix process; and in still other places by the stationary plant-mix process.

Highway engineers in extreme northern states require sufficient powered asphalt added to the asphaltic oil to produce an 85 penetration binder, and are obtaining very excellent mats with this consistency ma-

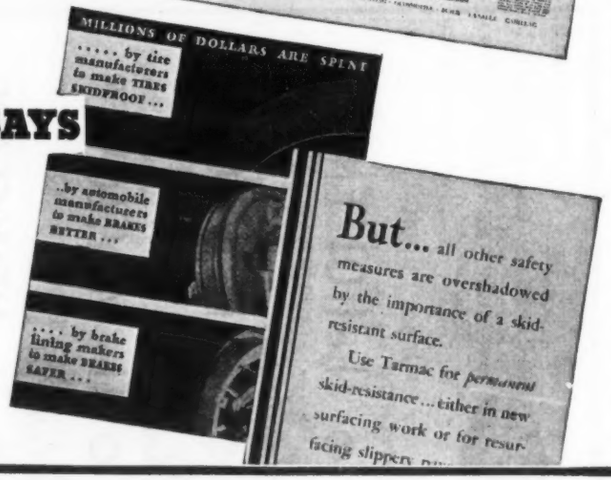
For best results..use TAR for skid resistance

1. GENERAL MOTORS SAYS

General Motors has just published in leading magazines this double page in which it points out that the money and ingenuity it puts into automobiles to add to the safety of the passengers, can be completely lost if the driver is careless . . . or the *road is dangerous.*

2. KOPPERS SAYS

For years, Koppers has been issuing hundreds of thousands of bulletins with that message. Slippery roads mean death and damage . . . skid-proof roads can be built . . . tar is the skid-resistant road material.

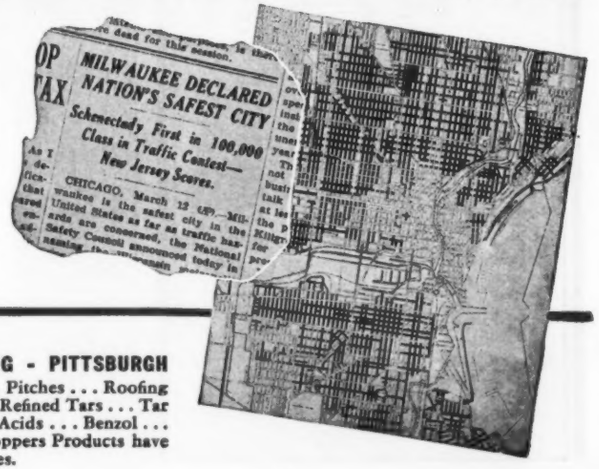

MILLIONS OF DOLLARS ARE SPENT
. . . . . by tire manufacturers to make TIRES SKIDPROOF . . .
. . by automobile manufacturers to make BRAKES BETTER . . .
. . . . by brake lining makers to make BRAKES SAFER . . .
But... all other safety measures are overshadowed by the importance of a skid-resistant surface.
Use Tarmac for permanent skid-resistance... either in new surfacing work or for resurfacing slippery

3. HIGHWAY OFFICIALS SAY

Actions speak louder than words . . and the actions of scores of highway officials show how well they realize the menace of slippery roads, and the effectiveness of tar in preventing skidding. These photographs show one of many dangerous slippery roads which have been treated with tar to eliminate their slipperiness and reduce accidents, and a second road being treated for the same purpose.

4. THE NATIONAL SAFETY COUNCIL SAYS

Each year the National Safety Council conducts a nation-wide traffic safety contest and names the safest city in America. This year, for the third successive time, Milwaukee has won that honor. *Milwaukee has used more tar on its streets than any other city in America.* The map herewith shows that 234 miles or 36% of Milwaukee's streets are paved with tar.


MILWAUKEE DECLARED NATION'S SAFEST CITY
Schenectady First in 100,000 Class in Traffic Contest—New Jersey Scores.
CHICAGO, March 12 (AP).—Milwaukee is the safest city in the United States as far as traffic hazards are concerned, the National Safety Council announced today in

KOPPERS

Tarmac

KOPPERS PRODUCTS COMPANY - KOPPERS BUILDING - PITTSBURGH

Tarmac Road Materials . . . Wood Preservatives . . . Roofing Pitches . . . Roofing Felts . . . Waterproofing . . . Industrial Pitches . . . Crude and Refined Tars . . . Tar Base Coatings . . . Tar Base Paints . . . Pitch Coke . . . Tar Acids . . . Benzol . . . Naphthalene . . . Agricultural Products. These and other Koppers Products have won a lasting place in hundreds of industries.

Remember the *classified* READERS' SERVICE DEPT., pages 63-65.

CONCRETE VIBRATORS Air operated vibrators for all classes of concrete construction including Bridge deck slabs, Dams and Locks, Highway pavement and Concrete products.

WRITE FOR CIRCULARS AND ENGINEERING DATA

MUNSELL CONCRETE VIBRATORS
TEANECK NEW JERSEY

CARL H. FRINK
MANUFACTURER
CLAYTON 1000 ISLANDS NEW YORK
DAVENPORT LOCO. & MFG. CORP. Davenport, Iowa
FRINK SNO-PLOWS of CANADA Ltd. Toronto, Ontario

DeWITT OPERATED HOTELS

featuring—
Unusually Comfortable Rooms, Good Food, Carefully Prepared, and Rates from $2.50 Single

In Cleveland it's
The HOLLENDEN
RADIO IN EVERY ROOM

In Columbus it's
The NEIL HOUSE

In Akron it's
The MAYFLOWER

In Toledo it's
The NEW SECOR

In Miami Beach it's
The FLEETWOOD
An Exclusive Winter Resort Hotel

DeWitt Operated Hotels are located in the heart of their respective cities

When writing, we will appreciate your mentioning PUBLIC WORKS.

terial. In general, most engineers use enough powdered asphalt to produce a 250 penetration binder, working midway between their desires to obtain the best binder and the limitations of their finances.

The asphaltic oil used to first-coat the aggregate in the oil-powder mixtures, ranges in viscosity from 300 to 1500 at 122° F., the average being about 500 viscosity. In the road-mix process the 500 viscosity oil works very good, readily coating the aggregate with a uniform film and requiring a minimum amount of discing, harrowing and blading. The use of too viscuous an asphaltic oil in the road-mix process necessitates a large amount of blading which would be unnecessary if the aggregate were primed with a more fluid oil and the desired binder obtained by adding a little more powdered asphalt.

The author of the above is connected with the Lincoln Oil Refining Company, which has developed for this purpose a fine powdered asphalt which it calls "Lincolnite"; and further information regarding methods of using it, details of construction procedure, etc. can be had by addressing him in care of the company at Robinson, Ill.

Diesel Tractors Operate Cheaply on Highway Construction

A comparison between gasoline and diesel tractors on a heavy earth-moving contract was made by Morris E. DeWitt of the Porter-DeWitt Construction Co., road builders of Kirkwood, Mo.

All tractors used in the test were caterpillars, but two were equipped with diesel engines and one with a gasoline motor. Careful cost records were kept by the owners and during a typical month's operation, the 60-horsepower gasoline tractor, pulling a blade scraper or scarifier, cost $104.75 in gasoline. Two diesels of 83 and 56 horsepower, pulling heavy scoops with a combined capacity of 15 yards, consumed together fuel costing only $128.82.

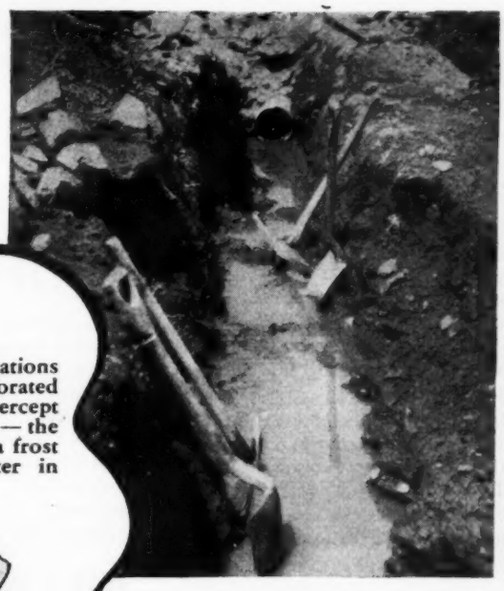
Inasmuch as some variation in number of hours existed, the owners analyzed the per hour cost, which for the gasoline tractor was 61 cents, and for the diesels only 16 cents.

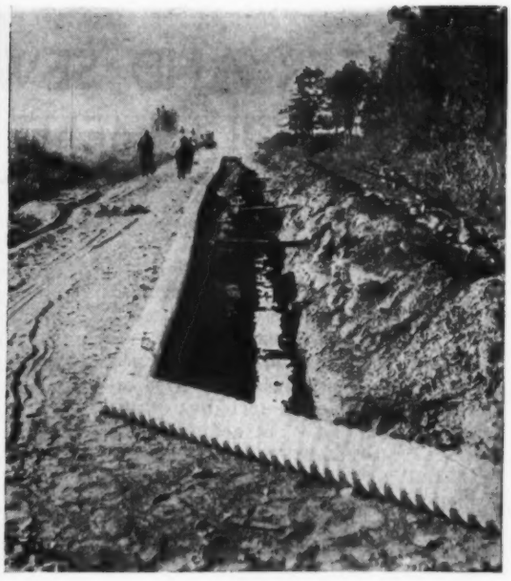
The diesel Seventy-five tractor consumed 3.72 gallons of fuel oil per hour while loaded with 12 yards of dirt. An average of 95 cubic yards per hour of "pay dirt" was moved by the outfit for 250 hours. The diesel Fifty tractor pulling a scraper used 2¼ gallons of fuel oil per hour during 1,570 hours of operation in nine months.

Pensacola's Proposed Treatment Plants

The sanitary sewerage system of Pensacola, Fla., drains to two separate outlets approximately a mile apart, where the raw sewage is discharged into Pensacola Bay. The city proposes, with PWA aid, to treat the sewage, plans for which have been made by Wiedeman and Singleton, while the construction will be under the supervision of O. J. Semmes, Jr., city engineer.

At the westerly outfall there will be mechanical bar screens, detritor, drag-type mechanical clarifiers and a pneumatic ejector for pumping sludge from this plant to the easterly plant. The sludge will be pumped about 3,000 feet to a main gravity sewer, into which it will be discharged to flow by gravity, mixed with sewage in this sewer, to the easterly plant. The easterly plant will have mechanical bar screens, some type of grinder for the screenings, detritor, drag-type clarifier, sludge pump, a two-stage digestor and sludge drying beds. Both plants will be equipped for complete chlorination when necessary, and both will discharge the clarified effluent through the present outfalls.





Two typical installations of Armco Perforated Pipe — one to intercept side hill seepage — the other to stop a frost heave. Note water in trenches.

Did You Ever Cross A Field DURING A WET SEASON?

IF you've ever crossed a field during a wet season, you know that *water-soaked ground can't carry much of a load.* That's why even the best road surfaces often crack and break up prematurely. Seepage water gets trapped underneath . . . wells up . . . and saturates the subgrade, making it soft and "mushy." Robbed of needed support, the road surface naturally gives way under the constant pounding of traffic.

Every year, thousands of dollars are spent in repairing damage of this kind—damage that could easily be prevented by *proper subdrainage.* For example, in hundreds of similar cases, where Armco Perforated Pipe has been installed, roadbeds have stayed dry and firm the year 'round. Moreover, many of these installations have *paid for themselves the first year*—by reducing maintenance.

Armco Perforated Pipe does not clog-up, break, or disjoint. It is strong, durable and highly efficient. Just to prove it to yourself, why not make a "test" of some stretch of road that is causing you trouble this spring? Experienced Armco engineers are at your service. Just mail the coupon below.

ARMCO CULVERT MFRS. ASSOCIATION
★ MIDDLETOWN, OHIO ★

ARMCO PERFORATED PIPE

LOWERS THE WATER TABLE

Send me free information on Armco Perforated Pipe for _____

Name _____

Title _____

Street _____

City _____ P W 5

Remember the *classified* READERS' SERVICE DEPT., pages 63-65.

WATER AND SEWAGE EQUIPMENT

Photoelectric Turbidicator

Before establishing the chemical dosage required properly to coagulate raw water, it is necessary to know its turbidity, and most modern equipped filtration plants must resort to periodical tests to determine the turbidity of the raw water supply, To facilitate these tests the Wayne Automatic Relay Co. of Fort Wayne, Indiana, has developed a photoelectric turbidicator. This instrument instantly indicates any change in the turbidity of the raw water by an ingenious arrangement of signals.

In operation the instrument is regulated to the existing turbidity at which the coagulant is being applied and is indicated by a midscale zero reading on a sensitive meter. The continuous burning of a white light indicates no change in the turbidity. Should any change occur in the turbidity it will instantly be observed by the protocell and relayed to the signals. The red light and a gong will denote an increase, the green light and a gong will denote a decrease. The meter will show the slightest drift in either condition.

The aging of the photocell, carbonization of the lamps or discoloration of the glass tank will have no effect upon its operation.

It is designed for either AC or DC operation on 110 volts, and is adaptable to any type filtration plant.

The working simplicity of this instrument enables any non-technical man to operate it. Information on request.

Sludge Dewatering Unit for Small Communities:

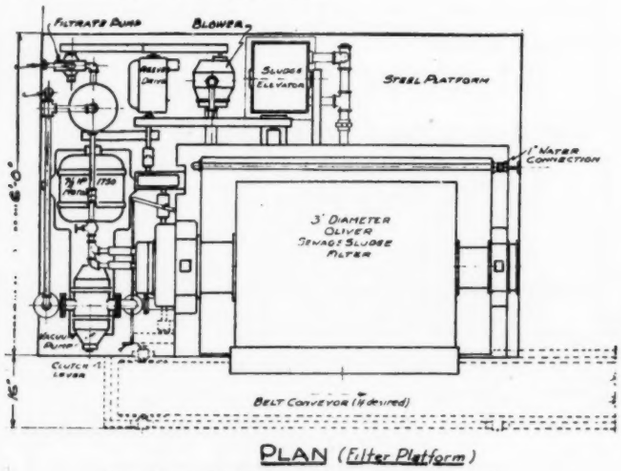
Oliver United Filters, Inc., announces the development of a sludge dewatering unit for smaller communities—those of approximately 10,000 population.

The unit is complete including all accessory equipment and interconnecting piping ready for installation. Three sizes are available, 18, 36 and 54 sq. ft. Over-all height is less than 9 ft. It can usually be installed in existing buildings.

Each unit includes sludge mixing tanks, either batch or continuous type, to effect the proper introduction of chemicals. It is so compact that it can be mounted on a truck to serve as a portable unit for two or more disposal plants.

This Oliver assembled sludge dewatering unit gives to the smaller communities the advantages that larger cities now have with mechanical dewatering of sludge. They, too, can enjoy nuisance-free handling of sludge. Operation is independent of weather conditions and costs are relatively low.

Full details can be obtained by writing the Oliver United Filters, Inc., 33 W. 42nd St., New York, or their Chicago or San Francisco offices.



PLAN (Filter Platform)

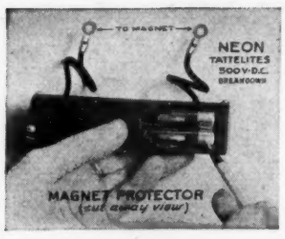
The Oliver Sludge Dewaterer for small plants

A "Tattletale" Fuse

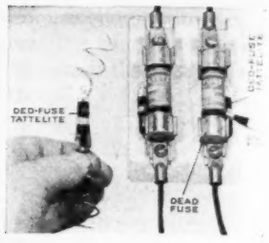
"Ded-Fuse Tattelite" is the name of a tiny neon lamp and casing designed to tell instantly when and where a fuse is blown out. This bulb, the size of a pencil tip, eliminates the need for hunting for blown fuses. It spots them right away. Designed for circuits of 100 to 550 volts, AC or DC. Cost only a few cents each. For description, etc., write E. V. Sundt, Littlefuse Laboratories, 1772 Wilson Ave., Chicago, Ill.

Neon Tattleites:

A new device has been brought out by Littelfuse Laboratories, 1772 Wilson Ave., Chicago, Ill., which is designed to prevent insulation breakdowns in direct current magnets, solenoids, shunt and compound wound motors and generators, coils, etc., due to high voltage self-induced surges, which occur when the circuit is suddenly opened. Even in 110-volt service, 10,000-volt surges are not uncommon. Full data on these will be sent on request.



Tattelite Protector

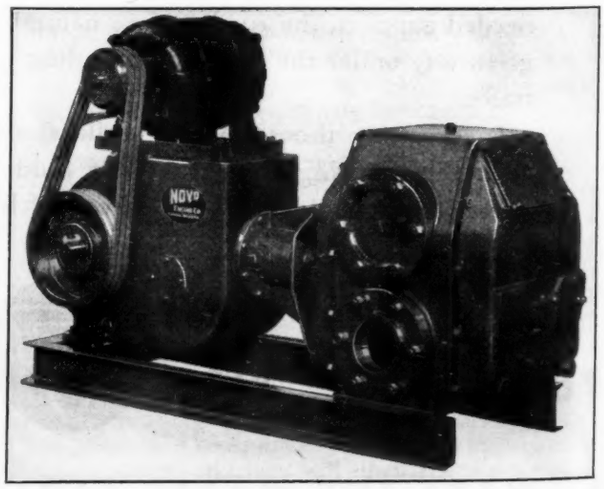


Ded-Fuse Tattelite

A New Way to Pump Sludge:

Ability to handle sludge over long periods without requiring cleaning is a very desirable characteristic of sludge pumps. It is also desirable to be able to clean the pump easily when the inevitable cleaning becomes necessary. These features are claimed for a new pump which has the suction at the top and the discharge at the bottom—thus handling the sludge in a straight line in accordance with the principles of gravity.

This pump has a very slow plunger speed, which handles the sludge with a minimum of agitation and stirring. It has a large valve area—21.6 square inches. The displacement per stroke is 3.08 gallons, giving a capacity of 92 gpm. at 30 rpm., and 154 gpm. at 50 rpm. The plunger seal is new and interesting. A fuller description of this pump can be obtained by writing for Bulletin 150 and specification sheet 150-A. Address Novo Engine Co., Lansing, Mich. One of these pumps has been in successful operation at the Grand Rapids sewage treatment plant for the past two years.



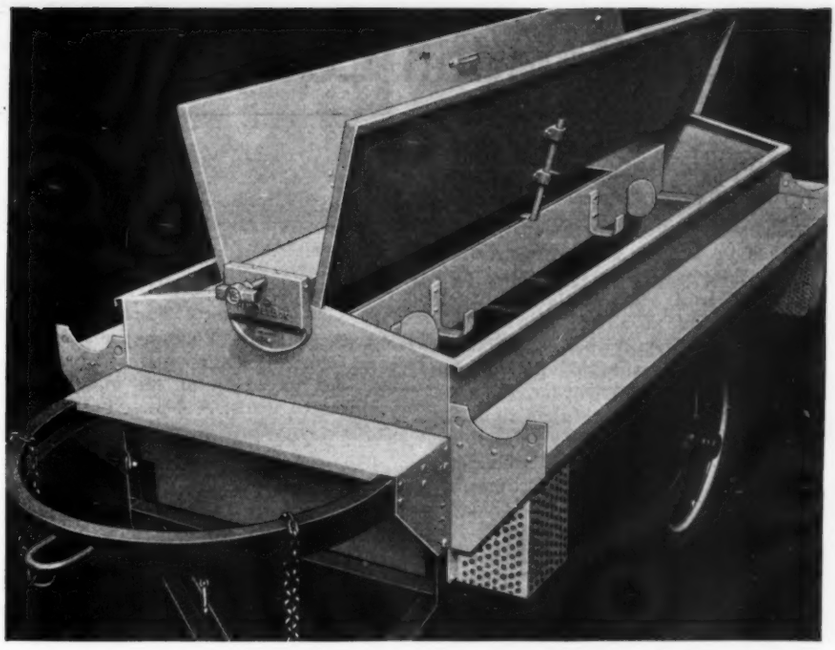
The Gravity-type Novo Sludge Pump

Protect Your TOOLS *in the Littleford* HANDEEBOX

When construction or maintenance gangs are equipped with the Littleford HanDeeBox, the foreman can keep an accurate check on all equipment.

This tool box is made of steel—it is actually lighter in weight than wooden boxes of equal capacity but is many times stronger. The double covers are locked simultaneously by one lock which fastens them full length of the box—it is impossible to pry open the covers. It is just like keeping your tools in a Safe!

Let us tell you about the HanDeeBox. Send for complete information, now. It will cost you nothing.



THE SIGN OF A GOOD HEATER LB LITTLEFORD BROS. CINCINNATI, OHIO

LITTLEFORD

Road Maintenance Equipment

SINCE 1900

LITTLEFORD BROS. 452 E. PEARL ST. CINCINNATI, O.

MUD-JACK METHOD

Pedestrian Hazard
• • •
3 inch Sunken Walk Slab

Hazard Eliminated
• • •
Slab Raised to Grade

Corrects Sunken Sidewalk Slab

One of many applications of the Mud-Jack method is the raising of sidewalk slab—the No. 10 N. E. C. MUD-JACK corrected the 3-inch settlement illustrated, in less than TEN MINUTES. Compare this with slab replacement costs. Depressed curb, gutter and street slab is quickly and efficiently raised to the correct grade by this modern economical method.

Write for Mud-Jack Bulletin

KOEHRING COMPANY

Milwaukee KOEHRING K HEAVY DUTY Wisconsin

For Raising Concrete Curb, Gutter, Walks, Street

Remember the *classified* READERS' SERVICE DEPT., pages 63-65.

Construction Equipment

For Smoother Form Construction

Smoother concrete and faster work are obtained by the use of plywood forms. On the Woodward Ave. widening project, in Detroit a description of which will appear in an early issue of this magazine, ⅜-in. plywood forms were used under ¾-in. shiplap, their use resulting in the elimination of board marks. The cost was a little higher than the usual forms, but the saving in rubbing offset the extra cost. If carefully handled, the forms could be used several times.

Laminex plyform is especially adapted for this work. A booklet giving full information concerning it, with sketches of forms, isometric views, and charts of form deflections can be obtained from J. M. McDonald, The Buchen Co., 400 West Madison St., Chicago, Ill.

A Good Road-Hog:

This road-hog is a grader, entirely new in design and construction, and especially adapted for highway construction and maintenance problems of 1935. Points of particular interest are the two-speed variable control power lift, and the pivoted spring suspended front end, eliminating chatter and side whip in high speed maintenance work.

This tractor is made in two sizes, so constructed that all standard makes of tractors may be used. For the 40-50 h.p. tractors, the frame is 10 inches deep and weighs 30 pounds per foot; for lighter tractors, a 10-inch frame weighing 25½ pounds per foot is used. The frame has 5 cross braces of tubular and box section construction.

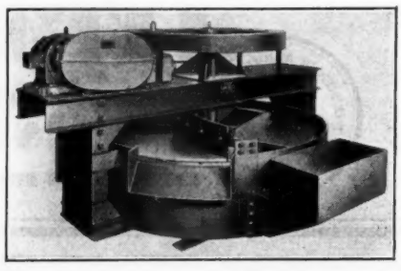
This new grader is the 1935 product of W. A. Riddell Co., Bucyrus, Ohio. It is known as Model 35. Fuller information and details on application for high-speed maintenance work and for construction will be sent on request. Address W. G. Beebe, care of the company.

Busters:

Three new busters are announced by the Sullivan Machinery Co., 400 No. Michigan Ave., Chicago, Ill. These are the K-9, K-10 and K-11. The K-9 weighs 46½ pounds, the K-10 77 pounds, and the K-11 84 pounds. The former is designed for work in narrow trenches, tunnels, etc.; the largest one will break the thickest pavement or the most heavily reinforced walls. A 4-page bulletin will be sent on request.

Link-Belt Dewatering Rotoscoop:

A dewatering rotoscoop has been announced by Link-Belt Company, Chicago, Philadelphia, as a perfected device for recovering fine or coarse sand and



Link-Belt Dewaterer

similar material. This is a sand dewatering device capable of recovering the available sand grains, of sufficient fineness to meet specifications, and discharging the product dry enough to permit truck transportation, or mechanical conveying to and from storage. It is suitable also for treating other materials besides sand, and provides a simple method of saving special grain sizes which were formerly lost in the overflow water.

The machine is made in four sizes; 15-ft., 12-ft., and 6-ft. diameters, with capacities ranging from 20 to 150 tons an hour, based on material weighing 100 lbs. per cu. ft.

Write for illustrated publication 1463, giving data on application, sizes, capacities, etc., to Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill.

Egg-Shaped Concrete Vibrators

New egg-shaped vibrators, especially designed for reaching into close quarters in wall work, bridge decks, columns, abutments and concrete pipe forms, has been announced by Munsell Concrete Vibrators, Teaneck, N. J. The shape of these air-driven vibrators is such as to permit their use in the most difficult positions, and to any depth of forms. These vibrators have only two moving parts. Frequencies of 3,500 to 4,500 can be obtained with only 80 to 90 pounds of air. These models are 5 inches in diameter at the largest point; thorough lubrication, which is a necessity with such fast-moving equipment, is a feature of these Munsell vibrators. Bulletin sent on request.

A Time Lock for Any Asphalt Mixer

Many highway departments are now requiring time locks on asphalt mixers, so as to attain the best results from mixing. A mechanical mixer timing device has been developed which fits on any existing asphalt plant, and which meets all state highway department specifications.

This includes a time lock, which allows regulation of mixing time from half a minute to four minutes, and a counting machine which automatically registers each batch mixed.

For further information regarding the application of one of these time locks to your asphalt mixing plant, write Hetherington & Berner, Inc., 701 Kentucky Ave., Indianapolis, Ind.

The Warco New-Design Road Grader

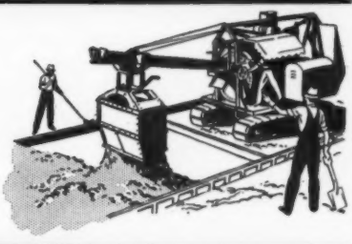
A Time Locking Device for Asphalt Mixers

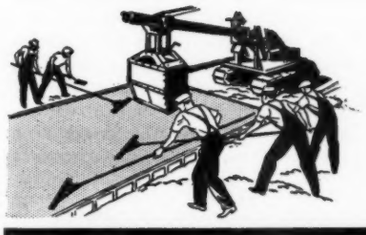
CALCIUM CHLORIDE

FOR MODERN CONCRETE CURING

To KEEP pace with the progressive trend of concrete paving and building construction in general, the important detail of curing must likewise follow the most modern and efficient method. The ideal method, as confirmed by researches of the National Bureau of Standards, Ohio State University and other authorities, is through CALCIUM CHLORIDE used integrally.

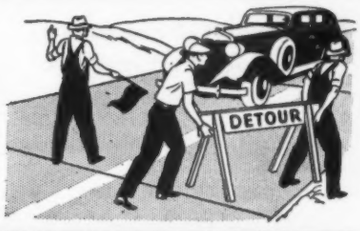
CONTROLLED MOISTURE CONTENT . . . **Calcium Chloride in the mix controls the moisture content of the concrete—thereby materially minimizing detrimental volume changes and hair checking.**

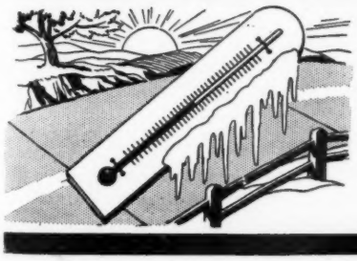




INCREASED WORKABILITY . . . **By enabling a reduction of ½ gallon of water content per sack of cement, Calcium Chloride maintains a workability of the concrete equal to that of plain cement concrete.**

GREATER DENSITY AND DURABILITY . . . **Calcium Chloride insures the development of high-strength concrete at all temperatures; and, due to its accelerated curing properties, enables earlier removal of forms and shortens the opening time for traffic by as much as one-half.**





ALL-WEATHER CONCRETING . . . **Due to Calcium Chloride's value for accelerating the curing, concreting is made a year-round rather than a seasonal industry.**

By effecting the advantages mentioned above, Calcium Chloride curing benefits: (1) The public through earlier use of the highways. (2) The taxpayer through a better return on his investment. (3) The contractor from savings through earlier job completion. . . . While public officials win praise for their efficient administration of highway improvements.

With road building and construction taking on a new impetus under the recently enacted Work Relief measure, full information on Calcium Chloride curing should be in every hand directing concreting work. Write for further literature. Address any of the following members of the

CALCIUM CHLORIDE ASSOCIATION

MICHIGAN ALKALI COMPANY . . 60 E. 42nd St., New York City
SOLVAY SALES CORPORATION . . 40 Rector St., New York City
THE DOW CHEMICAL COMPANY . . . . . Midland, Michigan
THE COLUMBIA ALKALI CORPORATION . . . . Barberton, Ohio

Remember the *classified* READERS' SERVICE DEPT., pages 63-65.

The American Water Works Association

THE 55th Annual Convention of this association will be held at the Hotel Nether'and Plaza, Cincinnati, O., May 6 to 10. The program of the meetings and notices of events, technical, gastronomic, social and athletic, fill six pages of a program the size of this page, and it is therefore impossible to reproduce the entire announcement here.

The whole range of the waterworks fie'd is covered by the program, including water purification, the drought, water planning, finance and accounting, design and construction, maintenance and operation. No matter which of the numerous meeting rooms one wanders into, he will find papers and discussions of interest and value. And, if he craves a little diversion, there is the boat ride (Wednesday afternoon), golf (Thursday), horse races (Saturday, May 4), inspection trips, and what nots.

The penalty for being much too good to hide its light longer under a bushel has fallen on the managers of the Water Purification division dinner. They can no longer keep attendance down to those who formerly understood and appreciated Bill Orchard's wit and ability so keenly. Everyone is invited, and it will be known as the "All-Division" dinner; 7.15 p. m., Tuesday.

Awards and Honors

To Frank E. Hale, director of laboratories, Mt. Prospect Laboratory, Department of Water Supply, Gas & Electricity, New York City, will be awarded the John M. Goodell prize for the work performed and its presentation in his paper "Pipe Corrosion Experiments, Catskill Supply, New York City." This paper appeared in the October, 1934, Journal of the American Water Works Association.

To Linn H. Enslow, editor of Water Works & Sewerage, and engineer of the Chlorine Institute, will be awarded the John M. Diven medal for outstanding service to the Association.

William Molis, superintendent of Water Works, Muscatine, Ia., and Dennis P. O'Brien of the A. P. Smith Mfg. Co., East Orange, N. J., have been elected to honorary membership.

Trains, Programs, Railroad Fare

Reduced rates of railroad fare will be in effect on all railroads, except for a few in the southwest. A special train will be run over the Pennsylvania and the L. & N., leaving New York Friday afternoon, May 3, which will go direct to Louisville, Ky., arriving in time to take in the races there.

Programs showing the detailed events of the convention are available on request to this magazine, to the American Water Works Association, New York City, or at the Netherland Plaza Hotel.

Boye Reelected Head of Asphalt Institue

At the annual meeting of the Board of Directors, the Asphalt Institute, representing 4/5 of the major producers of the United States and Canada, reelected B. L. Boye as its President. Mr. Boye has been with Socony-Vacuum for 35 years and now heads that company's asphalt and fuel oil activities.

The Institute announced the opening of a regional office in Cincinnati; additional regional offices are also maintained in Washington, San Francisco and Kansas City.

Other officers elected at the annual meeting were: Vice Presidents, A. M. Maxwell, Standard Oil Co. of Ohio; Leroy M. Law, She'l Petroleum Corp.; J. A. Blood, Standard Oil Co. of California, and T. M. Martin, Lion Oil Refining Co. of Arkansas. W. W. McFarland, President of the Warner Quinlan Co., was reelected Secretary and Herbert Spencer, Standard of New Jersey, was reelected Treasurer. The Board of Directors renamed C. W. Bayliss, Barber Asphalt Co., to be Chairman of the Executive Committee, and elected Messrs. McFarland, Martin and Blood as the other committee members, Mr. Boye being a member ex-officio. J. E. Pennybacker continues as managing director.

4-States Section, AWWA:

A VERY fine meeting of the 4-States Section, American Water Works Association, was held at Atlantic City, N. J., April 11 and 12. Harry R. Hall, deputy chief engineer of the Washington Suburban Sanitary District, as chairman of the section, presided at the meetings, and was largely responsible for the excellent program.

An outstanding paper of the first day was that by Robert B. Morse, chief engineer of the Washington Suburban Sanitary District, who described the Burnt Mills filtration plant. This plant contains many interesting features of design and construction. It is described on another page of this issue. H. T. Critchlow, division engineer of the New Jersey State Water Policy Commission, outlined the water supply situation in New Jersey in a complete and interesting fashion. This was discussed by Max Grossman, chairman of the commission. Joel Justin, consulting engineer of Philadelphia, showed interesting pictures covering the maintenance and repair of dams.

The second day opened with a paper on "Pipe Cleaning" by Charles Haydock, consulting engineer of Philadelphia, which was discussed by E. F. Muser, Manager, Chester Water Service Co. R. W. Haywood, Jr., superintendent of filtration of Easton, Pa., discussed his experiences in coagulating Delaware River Water, and this paper was commented on by L. L. Hedgepeth, manager of the Technical Service Department of the Pennsylvania Salt Co. A. E. Griffin of Wallace & Tiernan Co., presented a paper on "Evaluation of Residual Chlorine" which was discussed by E. S. Hopkins, Principal Sanitary Chemist, Montebello Filters, Baltimore, and Carl J. Lauter, chief chemist, Washington, D. C., filtration plants.

Isaac S. Walker was named chairman of the section, succeeding Mr. Hall; E. B. Whitman, Baltimore, was elected vice-chairman. Carl A. Hechmer and W. Compton Wills were elected trustees.

Personals

Jensen, Bowen & Farrell, engineers of Ann Arbor, Mich., have established a Traffic & Transportation Department for the purpose of engaging in street and highway traffic consulting work and general highway transport engineering. This department is being established in conjunction with the firm's long established public utility appraisal practice. The new department will be headed by D. Grant Mickle, a graduate of the University of Michigan, and formerly associated with Dr. Miller McClintock of the Erskine Bureau for Street Traffic Research at Harvard.

Frank Herring, formerly assistant Editor of Engineering News-Record, has resigned from that position to become assistant director of the secretarial staff of the American Society of Municipal Engineers and the International Association of Public Works Officials.

E. B. Sinclair has been appointed manager of the Public Works Department of The Autocar Company, manufacturers of heavy duty trucks. Mr. Sinclair will make his headquarters at the Autocar Branch in New York City. Mr. Sinclair is a native of Indianapolis, served in the Navy during the war, and later was a member of the staff of the United States Bureau of Public Roads, handling the disposal of surplus war material, principally to the states.

Publisher's Statement of Circulation

This is to certify that the average circulation per issue of PUBLIC WORKS for the six months' period July 1st to and including December 31st, 1934, was as follows:

Copies sold	8,459
Copies distributed free	1,041
Total	9,500

Signed: Public Works Journal Corp.
Publisher
W. A. Hardenbergh
Vice-President

Subscribed to and sworn before me on this 11th day of March, 1934.
Croxton Morris
(Notary Public)